MIOSHA Training Institute

MIOSHA Michigan Occupational Safety and Health Administration

Macomb Community College

Part 10.
Cranes & Derricks

Student Materials
MTI Level Two Compliance Course
Consultation Education & Training Division
Michigan Occupational Safety & Health Administration
Michigan Department of Licensing and Regulatory Affairs
www.michigan.gov/miosha
517-284-7720

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MIOSHA Michigan Occupational Safety and Health Administration

(Revised 06/16)

Part 10.
Cranes and Derricks

Presented By:
Consultation Education & Training (CET) Division
Michigan Occupational Safety & Health Administration
Michigan Department of Licensing and Regulatory Affairs
www.michigan.gov/miosha
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Welcome

"Every day in America, 13 people go to work and never come home.

Every year in America, nearly 4 million people suffer a workplace injury from which some may never recover.

These are preventable tragedies that disable our workers, devastate our families, and damage our economy.

American workers are not looking for a handout or a free lunch. They are looking for a good day's pay for a hard day's work. They just want to go to work, provide for their families, and get home in one piece."

– Secretary of Labor Hilda Solis

Objectives

- Recognize Hazards of Cranes and Excavators in Construction.
- Demonstrate understanding of Assembly/Disassembly, Inspection, Operational rules, Power line rules.
- Interpret Training Requirements for Operators, Riggers, Signal Persons, and all other personnel.
- Practice creating procedures that support compliance with Part 10.

Module One:
Introduction, Objectives, and Scope

New Federal OSHA Standard

- 1926 Subpart CC – Cranes and Derricks in Construction
- Effective November 8, 2010
- Major revision to the old standard

MIOSHA's Equivalent Standard

- Construction Safety Standard
  Part 10: Cranes and Derricks
- MIOSHA must be "at least as effective" as OSHA
- Much of the Federal OSHA standard was adopted
- MIOSHA effective date: 11-20-2012
- MIOSHA revised 3-15-2016 to remove excavators, elevators, hoists, and helicopters. Those are now in Part 15.

NIOSH/ CPWR Information in following slides

CPWR – The Center for Construction Research and Training – is the research arm of the Building and Construction Trades Department, AFL-CIO. This research was funded as part of a grant with CPWR from the National Institute for occupational Safety and Health, NIOSH (NIOSH Grant 1 U54OH008307). The research is solely the responsibility of the authors and does not necessarily represent the official views of NIOSH.

- Mike McCann: **mmccann@cpwr.com**
- Electronic Library of Construction Safety and Health (eLCOSH): **www.elcosh.org**
- CPWR – The Center for Construction Research and Training: **www.cpwr.com**

NIOSH

CPWR THE CENTER FOR CONSTRUCTION RESEARCH AND TRAINING

Crane-Related Deaths in Construction, 1992-2006

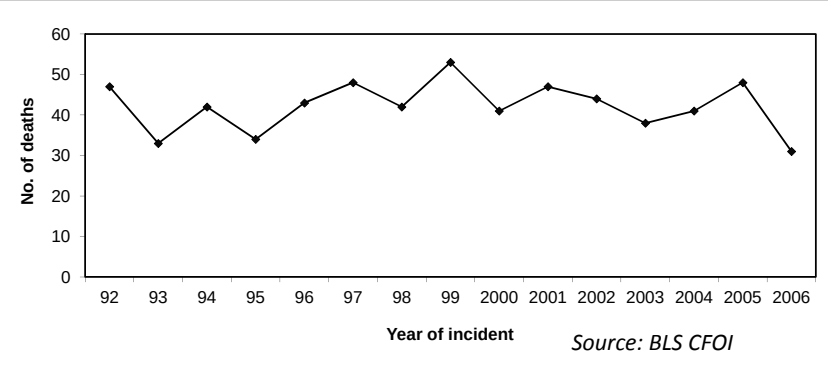
632 crane-related deaths

- An average of 42 deaths/year

18 multiple-death incidents involving a total of 40 deaths

Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries Research File. **Data identified by selecting CFOI Source and Secondary Source codes = "Cranes," and searching Narratives for key work "crane."**

Crane-Related Deaths in Construction by Year, 1992-2006



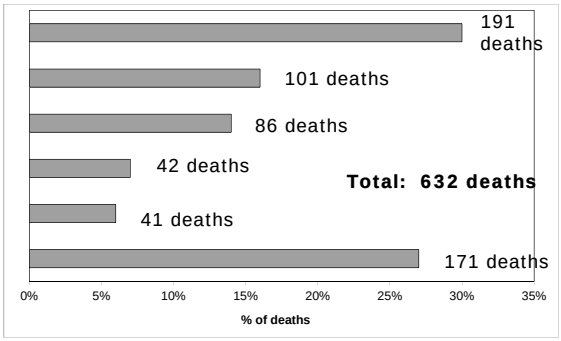
Source: BLS CFOI

Discussion questions:

- Is there any reduction in crane fatalities over time?
- Do you think that we need to change something to decrease fatalities or will it just get better on its own?

Trades of Workers Who Died

Crane-Related Deaths in Construction, 1992-2006

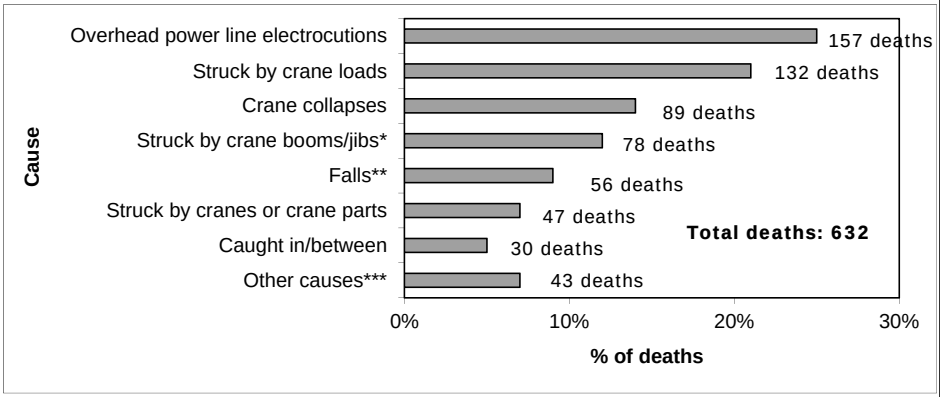


* Includes 62 crane and tower operators, 21 operating engineers and other construction equipment operators, and 7 hoist and winch operators.

** Includes 24 welders and cutters, 22 electrical workers, 21 mechanics, 17 sheet metal workers, 14 truck drivers, and 73 others.

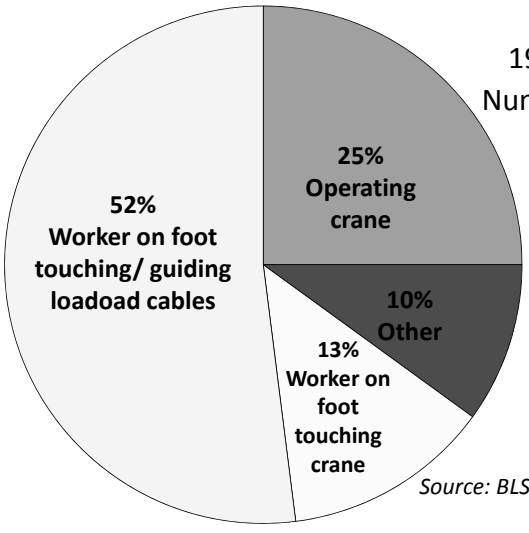
Source: BLS CFOI

Causes of Crane-Related Deaths in Construction, 1992-2006



* Included 64 struck by falling booms/jibs
** Included 21 falls from cranes, 9 falls from crane baskets, 8 from crane loads.
***Other causes included 9 highway incidents.
Source: BLS CFOI data

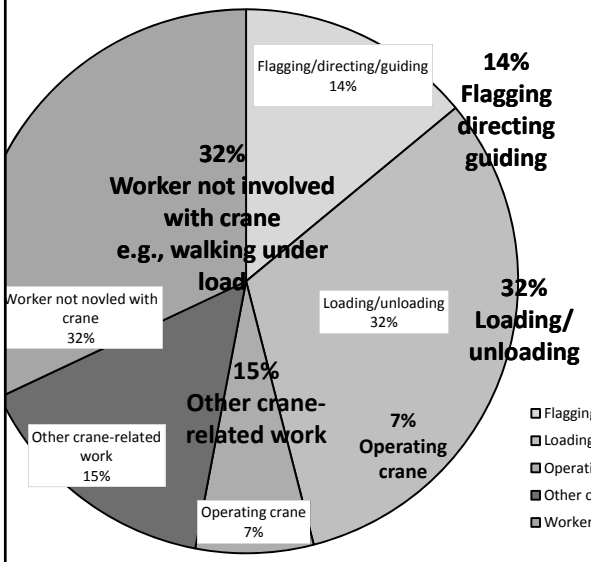
Overhead Power Line Electrocutions



1992 - 2006
Number of Deaths: 157

Source: BLS CFOI

Struck By Crane Loads



1992 - 2006

Number of Deaths: 132

Source: BLS CFOI

Mobile Cranes

At least 71% of all crane-related incidents involved mobile cranes

Mobile cranes were involved in:

- 80 of 95 (84%) of overhead power line incidents
- 37 of 59 (63%) of crane collapses
- 35 of 59 (60%) of struck by boom/jib incidents

Part 10 Scope

1001 (a)(1) This standard applies to power operated equipment, when used in construction, that can hoist, lower, and horizontally move a suspended load. Such equipment includes, but is not limited to, any of the following:

Scope: Included List

- Articulating cranes (such as knuckle-boom cranes)
- Crawler cranes
- Floating cranes
- Cranes on barges
- Locomotive cranes
- Mobile cranes
  - Wheel-mounted
  - Rough-terrain
  - All-terrain
  - Commercial truck-mounted
  - Boom truck cranes

Scope: Included List

- Industrial cranes, such as carry-deck cranes
- Dedicated pile drivers
- Service/mechanic trucks with a hoisting device
- Crane on a monorail
- Tower cranes, such as a fixed jib, ‘‘hammerhead boom,’’ luffing boom and self-erecting

Scope: Included List

- Pedestal cranes
- Portal cranes
- Overhead and gantry cranes
- Straddle cranes
- Side-boom cranes
- Derricks
- Variations of equipment listed.

Scope: Included List

1001 (3)(g) Multi-Function Machines when configured to hoist and lower by means of a winch and hook and horizontally move a suspended load.

No winch on these 2 attachments, so not included.

forkjibattachments.com.au

productionfab.com

Scope: Attachments

1001 (2) This standard applies to equipment included in subrule (1) of this rule when used with attachments. These attachments, whether crane-attached or suspended include, but are not limited, to any of the following:

- (a) Hooks
- (b) Magnets
- (c) Grapples

Scope: Attachments
1001 (2)

- (d) Clamshell buckets
- (e) Orange peel buckets
- (f) Concrete buckets
- (g) Drag lines
- (h) Personnel platforms
- (i) Augers or drills
- (j) Pile driving equipment

Specific Exclusions

1001 (3)(a) Exclusions include, but are not limited to:

- (i) Wheel loaders and backhoes
- (ii) Loader backhoes
- (iii) Track loader
- (iv) Concrete pumps

This machinery is also excluded when used with chains, slings, or other rigging to lift suspended loads.

Specific Exclusions

- 1001(3)(d) Digger derricks used in work subject to construction safety standard part 16 “Power Transmission and Distribution”
- 1001 (3)(f) – (o), gantry systems, stacker cranes, mechanic’s truck, come-a-longs, chainfalls, dedicated drilling rigs, ginpoles used for erecting communication towers, tree trimming and removal work, roustabouts
- 1001 (3)(h) Powered industrial trucks (except when using a winch and hook)

Specific Exclusions

1001 (3)(e) Machinery originally designed as vehicle-mounted aerial devices for lifting personnel and self-propelled elevating work platforms.

Specific Exclusions

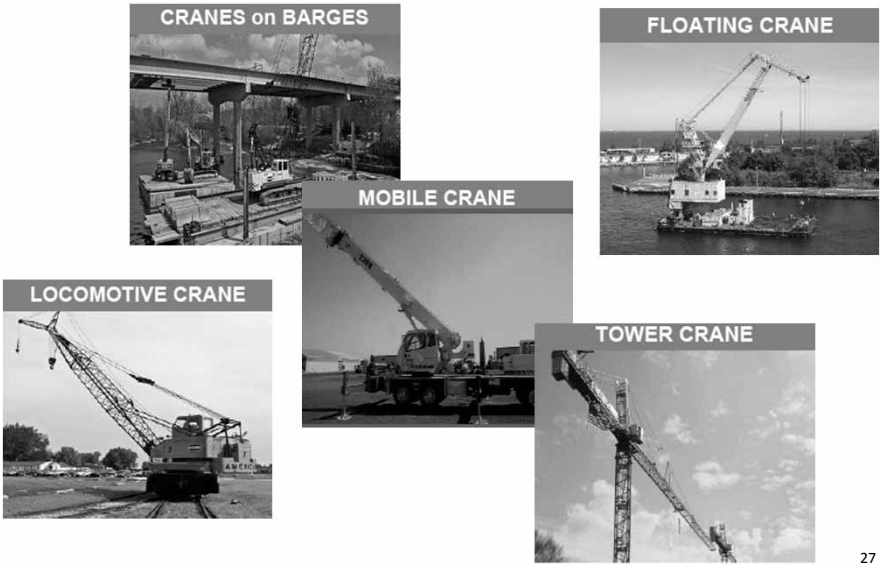
http://www.articulatingcranes.com/

1001 (3)(p)(i) Articulating/knuckle-boom truck cranes that deliver material to a construction site when used to transfer materials from the truck crane to the ground, without arranging the materials in a particular sequence for hoisting.

Specific Exclusions

1001 (3)(p)(ii) Articulating/knuckle-boom truck cranes that deliver material to a construction site when the crane is used to transfer building supply sheet goods from the truck onto a structure , using a fork and cradle at the end of the boom, but only when the truck is equipped with a properly functioning automatic overload prevention device. Includes: sheetrock, plywood, bags of cement, packages of roofing shingles, rolls of roofing felt.

Types of Cranes



Types of Cranes

Module Two: Assembly / Disassembly

Definition

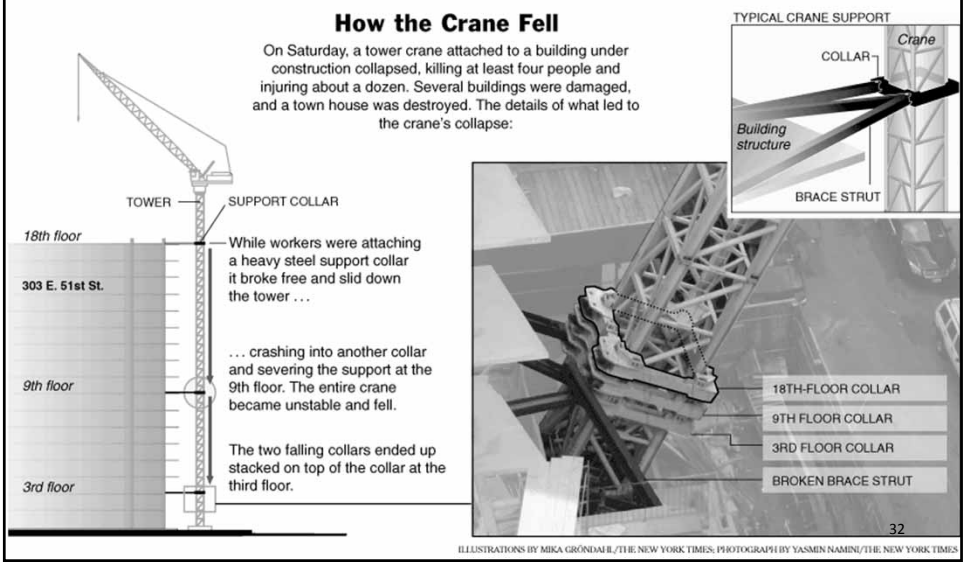
"Assembly and Disassembly" means the assembly, disassembly, or both, of equipment covered under this standard. With regard to tower cranes, this includes ''climbing'' and ''dismantling.''

All cranes require some assembly and disassembly, even if that is just determining where to put the crane and deploying the outriggers.

Assembly / Disassembly Hazards

- Electrical hazards.
- Crane setup, level and ground conditions.
- Struck by.
- Overloading knowing the weights and utilizing the load charts properly.
- Underground utilities not identified.
- Working within the swing radius.

A/D Hazards: NYC Tower Crane 2008



ILLUSTRATIONS BY MIKA GRÖNDAHL/THE NEW YORK TIMES; PHOTOGRAPH BY YASMIN NAMINI/THE NEW YORK TIMES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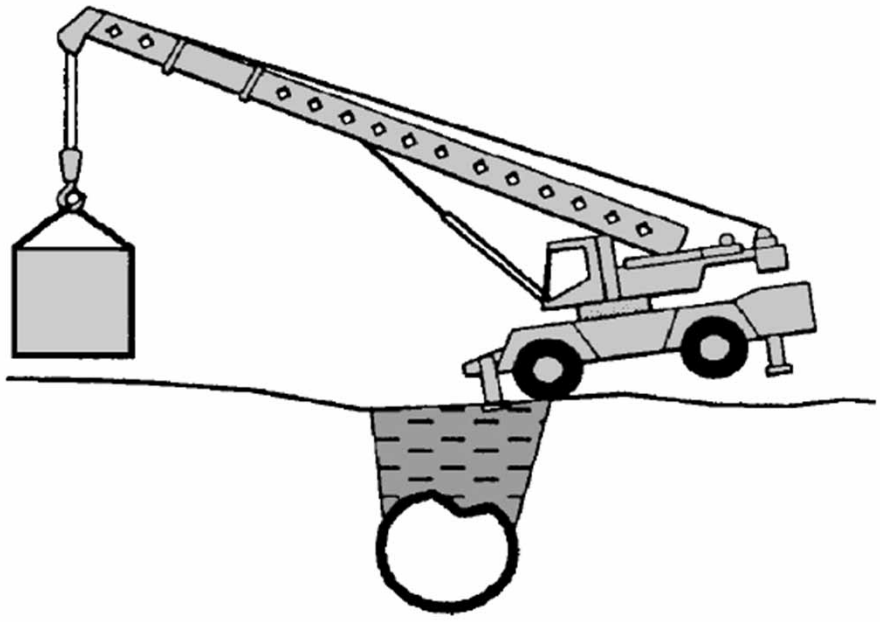
Ground Conditions

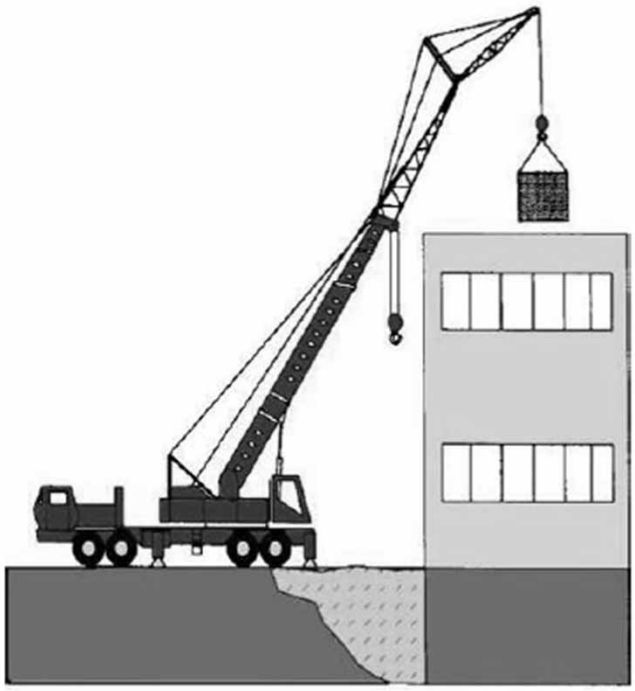
1017 (1) The equipment shall not be assembled or used unless ground conditions are **firm, drained, and graded** to a sufficient extent so that, in conjunction with the use of **supporting materials** if necessary, the equipment **manufacturer's specifications** for adequate support and degree of level of the equipment are met.

Ground Conditions

1017 (2) The **controlling entity** shall do both of the following:

- (a) Ensure ground preparations necessary to meet the (ground condition) requirements
- (b) Inform the user of the equipment and the operator of the location of hazards beneath the equipment set-up area;
  - Voids,
  - Tanks
  - Utilities
  - Hazards are identified in documents, such as site drawings, as-built drawings, and soil analyses





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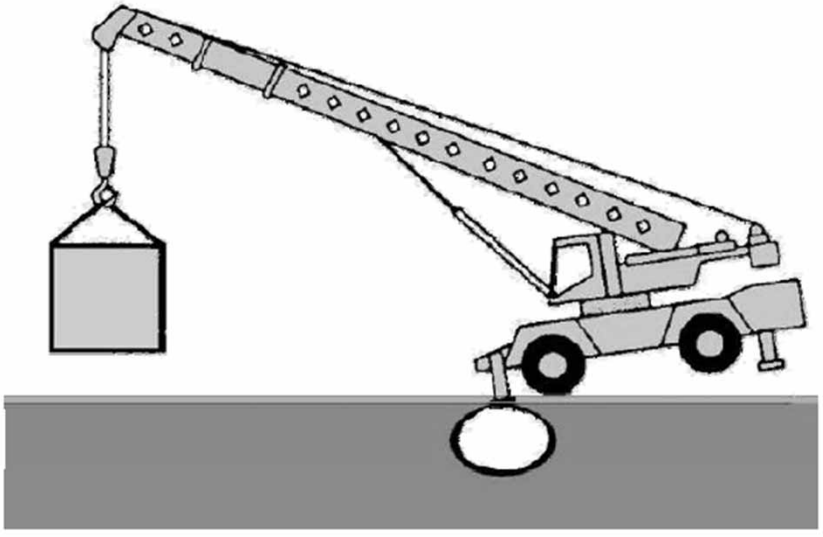

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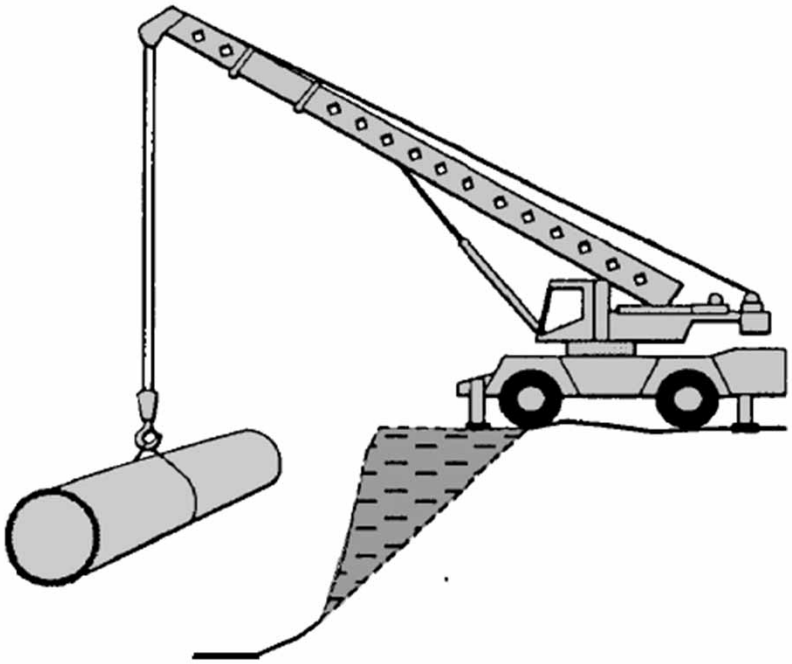


Mat vs. No Mat

Qualified Person is Needed

lbs. / sq. inches = psi

What is the force being delivered to each outrigger?

What can the soil bear?

What size cribbing or mat do you need?

Applicable rules:
A/D: 1035b (2)
Operations: 1017 (2)

Clay	Loose Firm Compact	13 psi 33 psi 54 psi
Silt	Loose Firm Compact	27 psi 33 psi 40 psi
Sand-Fine, Silty, or with trace of Clay compact	Loose Firm Compact	27 psi 40 psi 54 psi
Sand- Course to Medium	Loose Firm Compact	40 psi 60 psi 81 psi
Gravel – Sand and Gravel	Loose Firm Compact	54 psi 81 psi 110 psi

Do the math

lbs. / sq. inches = psi

You are lifting 45,000 pounds

As you look at the soil on site, you see it is sand. Not sure how coarse or how compact?

What size cribbing or mat do you need?

Clay	Loose Firm Compact	13 psi 33 psi 54 psi
Silt	Loose Firm Compact	27 psi 33 psi 40 psi
Sand-Fine, Silty, or with trace of Clay compact	Loose Firm Compact	27 psi 40 psi 54 psi
Sand- Coarse to Medium	Loose Firm Compact	40 psi 60 psi 81 psi
Gravel – Sand and Gravel	Loose Firm Compact	54 psi 81 psi 110 psi

Do the math

Must select the weakest sand.

lbs. / sq. inches = psi

45,000 lbs / Y = 27 psi

Convert the formula:
Y = 45000 / 27 psi
Y = 1,666.7 sq. inches

What size mat do you need?
2’ x 2’ = 24” x 24” = 576 sq inches
3’ x 3’ = 36” x 36” = 1296 sq inches
4’ x 4’ = 48’ x 48’ = 2304 sq inches

Clay	Loose Firm Compact	13 psi 33 psi 54 psi
Silt	Loose Firm Compact	27 psi 33 psi 40 psi
Sand-Fine, Silty, or with trace of Clay compact	**Loose** Firm Compact	**27 psi** 40 psi 54 psi
Sand- Coarse to Medium	Loose Firm Compact	40 psi 60 psi 81 psi
Gravel – Sand and Gravel	Loose Firm Compact	54 psi 81 psi 110 psi

Ground Conditions

- Cracks in the asphalt/concrete paving? Have there been any new patches?
- Who evaluated the ground conditions?
- Is it firm and drained?
- Is crane set up on previously disturbed soil?
- Over utilities or vaults or near new buildings?
- What type of soil is present?
- Does the crane operators manual give any direction for set up?

Assembly / Disassembly

Rule 1035.

Two options:

Manufacturer procedures

or

Employer procedures

- follow 1035d., procedures developed by qualified person

Assembly / Disassembly

1035a "A/D director"

- (1) Is both a "competent person" and a "qualified person."
- (2) Must understand the applicable A/D procedures.
- (3) Must review the applicable procedures immediately prior to A/D begins.
- (4) Must instruct crew of their tasks, hazards associated with tasks, and any hazardous locations to avoid.
- Follow manufacturer's prohibitions.
- All rigging work is done by a Qualified Rigger.
- When using outriggers - fully extend *or* deploy as per the load chart.

Assembly / Disassembly

1035b. (1) A/D director shall address the following hazards:

- (2) Site and ground bearing conditions
- (3) (4) Blocking material & location
- (7) Pick points & center of gravity of the load
- (8) Stability upon pin removal
- (9) Snagging
- (10) Struck by hazard from counterweights
- (11) Boom hoist brake failure
- (12) Loss of backward stability
- (13) Wind speed and weather
- (14) Cantilevered boom sections
- (15) Weight of components
- (16) Components and configuration
- (17) Shipping pins
- (18) Pile driving
- (19) Outriggers and stabilizers
- (20) Locomotive cranes
- (21) Rigging: Part 8 sling use requirements, qualified rigger

1035b. (19) Outriggers and Stabilizers

- (a) The outriggers or stabilizers shall be either fully extended or, if the manufacturer's procedures permit, deployed as specified in the load chart.

- (b) The outriggers shall be set to remove the equipment weight from the wheels.

Post-assembly Inspection

Upon completion of assembly, the equipment shall be inspected by a qualified person.

Good thing we found these giant cracks!

Activity One: A/D Policy

With a partner, pick a crane type you are familiar with.

Outline A/D company policy items.

- Think about the entire process from before A/D begins through completion.
- Consider training, documentation, planning, oversight, review, etc.
- Think about the checks and balances you can put in place to ensure that you don't have failures.
- Share with class.

15 minutes

Module Three: Inspections

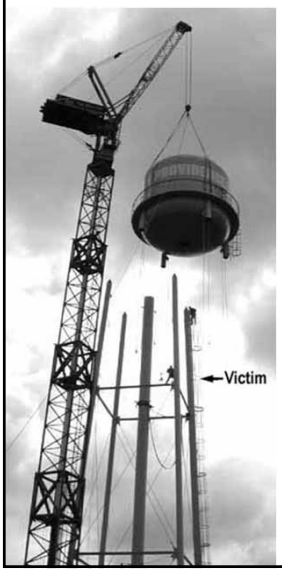
Inspections: Objectives

This lesson will enable you to assess compliance of crane operation inspections specifically, you will be able to:

- Explain MIOSHA crane inspection process requirements.
- Examine all inspection documentation.
- Determine compliance crane and wire rope inspections.
- Recognize common violations [hazards] of MIOSHA requirements /possible citations regarding crane inspections.

What Just Happened?

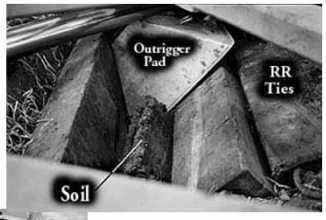
Hazards of Not Doing Inspections Each Shift



- Iowa, July 2000
- Erecting a water tower
- Outrigger set close to new foundation
- Poor ground conditions generally

Hazards of Not Doing Inspections Each Shift

- Cribbing instead of crane mats
- Soft, muddy ground



Source: Iowa FACE Program

Inspections: Manufacturer's Procedures

- 1037f. (3) Any part of a manufacturer's procedures regarding inspections that relate to safe operation that is more comprehensive or has a more frequent schedule of inspection than the requirements of this rule shall be followed.
- In other words, before doing ANY inspection, check with the manufacturer to determine if they have specific inspection procedures. Follow those if more stringent than MIOSHA.

Activity Two: Types of Inspections Required

Activity: Take this page out of your materials and complete it during this module.

Type	Inspector Qualifications	Documented?	What to Inspect?
Post Assembly	Qualified person		
Shift (Daily)	Competent person		
Monthly			
Annual			
Modifications			
Repairs or Adjustments			
Severe Service			

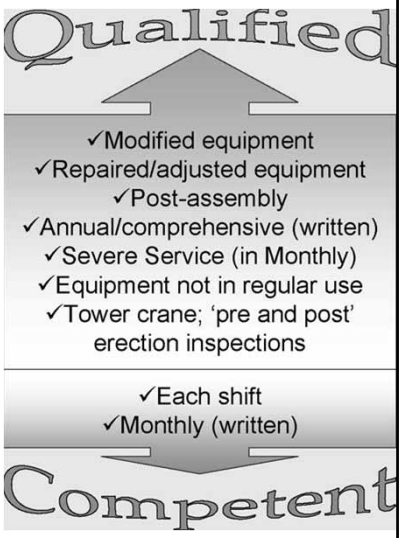
Inspector Qualifications

Qualified person defined:

A person who, through attainment of a recognized degree or certificate of professional standing or by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

Competent person defined:

A person who is trained, experienced, and capable of identifying an existing or potential hazard in surroundings, or under working conditions, that are hazardous or dangerous to an employee and who has the authority and knowledge to take prompt corrective measures to eliminate the hazards.



Post-Assembly Inspection

- 1037b.(1)(a) Upon completion of assembly, a **qualified person** shall inspect the equipment to ensure that it is configured in accordance with manufacturer equipment criteria.

- Simply stated: Somebody qualified verifies that the crane is put together properly. This requires documents from the manufacturer that specify appropriate configurations and assembly details (e.g. bolt torque).

- 1037b.(3) Equipment shall not be used until an inspection under this rule demonstrates that the equipment is configured in accordance with the applicable criteria.

Shift Inspections

1037c. (1) A **competent** person shall **begin** a visual inspection prior to each shift.

- Must be completed before or during that shift.
- Observation for apparent deficiencies.
- Taking apart equipment components and booming down not required.
- Determinations made in conducting the inspection shall be reassessed in light of observations made during operation.
  - —Example: everything seemed fine, but now there is a screeching sound whenever the boom is lowered.

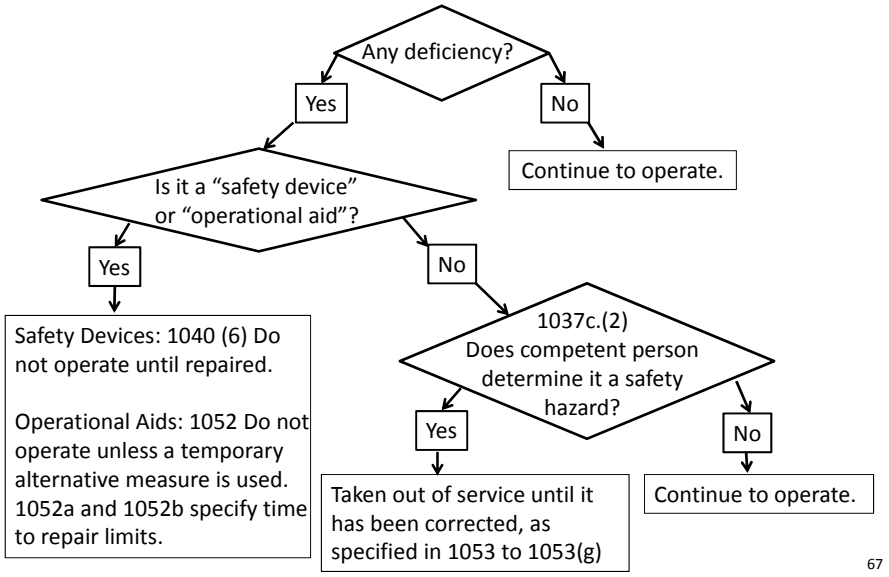
Shift Inspections: Deficiencies Found

- 1037c. (2) If any deficiency, a competent person shall make an immediate determination as to whether the deficiency constitutes a safety hazard. If the deficiency is determined to constitute a safety hazard, the employer shall ensure that the equipment is taken out of service until it is corrected, as specified in R 408.41053 to R 408.41053g.

Shift Inspections: Deficiencies Found

- 1037c. (3) If there is any deficiency in safety devices and operational aids for proper operation identified, the employer shall ensure that the action specified in R 408.41040 and R 408.41052 to R 408.41052b is taken prior to using the equipment.

Shift Inspection: Deficiencies



"Safety Devices" and "Operational Aids?"

- ***Safety Device defined***: A device used to prevent the unwanted or unsafe operation of a piece of equipment.
- 1040 Examples:
  - Crane level indicator
  - Boom stops and jib stops
  - Locks on foot pedal brakes
  - Integral holding device or check valve on hydraulic outrigger jacks / stabilizers
  - Horn
  - Rail clamps on rails

"Safety Devices" and "Operational Aids?"

- ***Operational Aid defined***: Devices that assist the operator in the safe operation of the crane by providing information or automatically taking control of a crane function.
- 1052. Examples:
  - Boom angle indicator
  - Luffing jib limiting device
  - Anti two-block device
  - Boom length indicator
  - Load weighing device

Monthly Inspections

- 1037d. (1) Equipment that is in service is inspected monthly in accordance with 1037c.

  - 1037c. Is shift inspection

- (2) Equipment shall not be used until an inspection under these rules demonstrates that no corrective action under 1037c (2) and (3) is required.

Monthly Inspections: Documentation

1037d. (3) The following information shall be documented and maintained by the employer that conducts the inspection:

- (a) The items checked and the results of the inspection.
- (b) The name and signature of the person who conducted the inspection and the date.

- 1037d. (4) This document shall be retained for a minimum of 3 months.

- So, in short, a monthly inspection is the same as a shift inspection, but it must be documented.

- Discussion question: Do you think you might want to retain documents for more than 3 months?

Activity: Shift (and Monthly) Inspections

- Partner with the person next to you.
- Work together to match the required inspection items in the list with the picture that best depicts that item.

Example: Hydraulic system for proper fluid level.

Activity Three : Shift (and Monthly) Inspections

- Partner with the person next to you.
- Match the required inspection items with the pictures.

__ i. Control mechanisms for maladjustments interfering with proper operation.
__ii. Control and drive mechanisms for apparent wear or contamination.
__iii. Air, hydraulic and other pressurized lines for deterioration or leakage.
__iv. Hydraulic system for proper fluid level.
__v. Hooks and latches for deformation, cracks, excessive wear, or damage.
__vi. Wire rope reeving for compliance with the manufacturer's specifications.
__vii. Wire rope, in accordance with wire rope shift inspection.
__viii. Electrical apparatus for malfunctioning, excessive deterioration, dirt or moisture accumulation.
__ix. Tires (when in use) for proper inflation and condition.
__x. Ground conditions support, settling, water accumulation, or similar.
__xi. Equipment for level position within the manufacturers tolerances.
__xii. Operator cab windows for cracks, breaks, other deficiencies that would hamper the operator's view.
__xiii. Safety devices and operational aids for proper operation.

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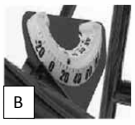
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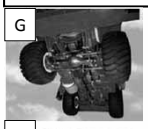
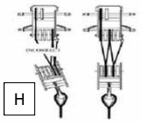
G 

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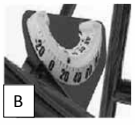
Activity: Shift (and Monthly) Inspections

- Partner with the person next to you.
- Match the required inspection items with the pictures.

D_ i. Control mechanisms for maladjustments interfering with proper operation.
G_ii. Control and drive mechanisms for apparent wear or contamination.
I_iii. Air, hydraulic and other pressurized lines for deterioration or leakage.
J_iv. Hydraulic system for proper fluid level.
A_v. Hooks and latches for deformation, cracks, excessive wear, or damage.
H_vi. Wire rope reeving for compliance with the manufacturer's specifications.
K_vii. Wire rope, in accordance with wire rope shift inspection.
L_viii. Electrical apparatus for malfunctioning, excessive deterioration, dirt or moisture accumulation.
F_ix. Tires (when in use) for proper inflation and condition.
M_x. Ground conditions support, settling, water accumulation, or similar.
E_xi. Equipment for level position within the manufacturers tolerances.
C_xii. Operator cab windows for cracks, breaks, other deficiencies that would hamper the operator's view.
B_xiii. Safety devices and operational aids for proper operation.

A 

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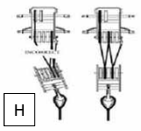
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Types of Inspections

WHEN	Inspector Qualifications	Documented?	What to Inspect?
Post Assembly	Qualified Person	Not addressed*	See 1037b. (1)
Shift (Daily)	Competent Person	No	1037c. (1) (a) to (n)
Monthly	Competent Person	Yes. Save 3 months	1037c. (1) (a) to (n)
Annual	Qualified Person		
Modifications	Qualified Person		
Repairs or Adjustments	Qualified Person		
Severe Service	Qualified Person		

Annual Inspections

- 1037e. (1) At least every 12 months, a qualified person shall inspect the equipment in accordance with 1037c, except that the corrective action set forth in subrules (3), (4), and (5) of this rule shall apply in place of the corrective action required by 1037c(2) and (3).
- 1037e. (2) In addition, at least every 12 months, the equipment shall be inspected by a qualified person. **Disassembly shall be required, as necessary, to complete the inspection**. *(List of items (a) through (w) follows this paragraph)*
- 1037e. (3) This inspection shall include functional testing of the equipment as configured to determine if it is functioning properly.

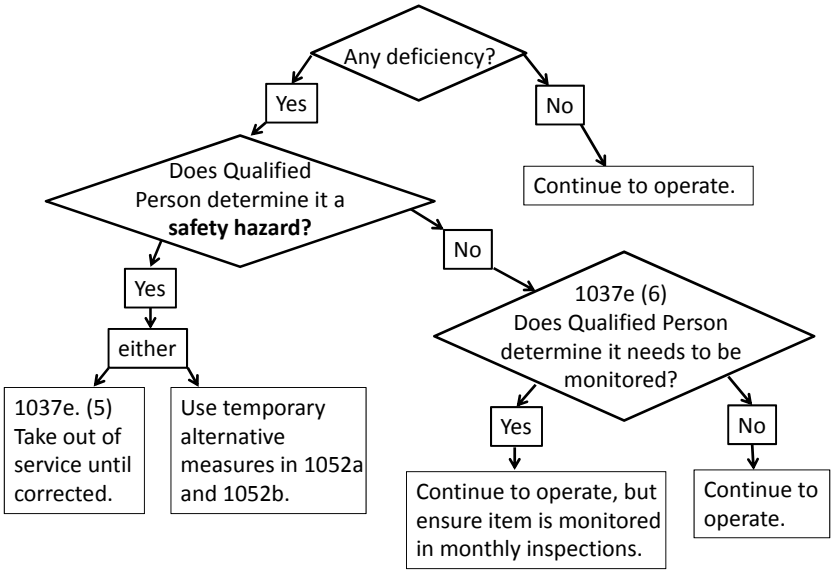
Annual Inspections

- 1037e. (4) If any deficiency is identified, a qualified person shall make an immediate determination as to whether the deficiency constitutes a safety hazard or, though not yet a safety hazard, needs to be monitored in the monthly inspections.
- Note: no decision based on “safety device” or “operational aid.” The decision is based simply on the qualified person’s judgment.

Annual Inspections

- 1037e. (5) If a deficiency is a safety hazard, the equipment shall be taken out of service until it has been corrected, except when temporary alternative measures are implemented as specified in 1052a or 1052b. See 1053.
- 1037e. (6) If not presently a safety hazard, the deficiency needs to be monitored, the employer shall ensure that the deficiency is checked in the monthly inspections.

Annual Inspection: Deficiencies

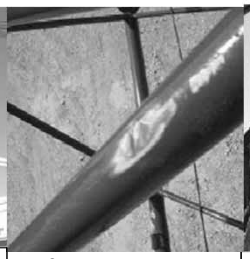


Annual Inspections: Documentation

- 1037e. (7) The following information shall be documented, maintained, and retained for a minimum of 12 months by the employer that conducts the inspection:
  - (a) The items checked and the results of the inspection.
  - (b) The name and signature of the person who conducted the inspection and the date.

Annual Inspections

Some of the Additional Items Required to be Inspected.

			
Equipment structure, including the boom.	Deformed, cracked, or significantly corroded structural members.	Loose, failed, or significantly corroded bolts, rivets, and other fasteners.	Cracked welds.

Annual Inspections

Some of the Additional Items Required to be Inspected.

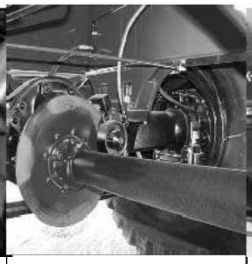
			
Sheaves and drums for cracks or significant wear.	Pins, bearings, shafts, gears, rollers and locking devices for distortion, cracks or significant wear.	Brake and clutch system parts, linings, pawls and ratchets for excessive wear.	Safety devices operational aids for proper operation.

Annual Inspections

Some of the Additional Items Required to be Inspected

Power plants for safety-related problems leaking exhaust emergency shut-down feature and proper operation.

Chains and drive sprockets for excessive wear excessive chain stretch.

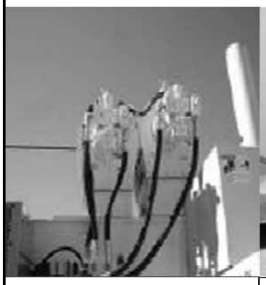


Travel steering, brakes, and locking devices, for proper operation.

Tires for damage or excessive wear.

Annual Inspections

Some of the Additional Items Required to be Inspected



Hydraulic, pneumatic and other pressurized hoses, fittings and tubing.

Hydraulic and pneumatic pumps and motors.

Hydraulic and pneumatic valves.

Hydraulic and pneumatic cylinders.

Inspections: Annual

Outrigger or stabilizer pads and floats for excessive wear or cracks.

Slider pads for excessive wear or cracks.

Electrical components and wiring for cracked or split insulation and loose or corroded Terminations.

Missing or unreadable warning labels and decals.

Annual Inspections

Some of the Additional Items Required to be Inspected

Originally equipped operator seat (or equivalent): missing.

Operator seat: Unserviceable.

Originally equipped steps, ladders, handrails, guards: missing.

Steps, ladders, handrails, guards: in unusable/ unsafe condition.

Modified Equipment Inspections

1037 (1) Equipment that has had modifications or additions which affect the safe operation of the equipment or capacity **shall be inspected by a qualified person** prior to use.

- (a) Inspection that the modifications or additions have been done in accordance with the approval obtained pursuant to 1083 (approved by the manufacturer in writing).
- (b) Include functional testing of the equipment.

Inspections After Repairs or Adjustments

- 1037a. (1) Repairs or adjustments that relate to safe operation shall be inspected by a qualified person prior to initial use.
- 1037a. (1) Inspection requirements:
  - (a) Must meet manufacturer equipment criteria.
  - (c) Include functional testing of the repaired or adjusted parts.
- 1037a. (2) Equipment shall not be used until an inspection demonstrates that the repair or adjustment meets the requirements.

Severe Service Inspections

1037f. (1) Where the severity of use or damaging/excessive conditions, the employer shall stop using the equipment and a qualified person shall:

- (a) Inspect the equipment for structural damage to determine if the equipment can continue to be used safely.
- (b) In light of the use or conditions determine whether any items and conditions listed in 1037e need to be inspected and inspect those items and conditions.
- (c) If a deficiency is found, the employer shall follow the requirements in 1037e. (3) to (5).

1037e = Annual inspections

Inspections: Documents Available

- 1037 (4) All documents produced under this rule shall be available, during the applicable document retention period, to all persons who conduct inspections under this rule.
- In other words, documentation must be ON THE CRANE so the operator can review it for each shift inspection.

Types of Inspections**

WHEN	Inspector Qualifications	Documented?	What to Inspect?
Post Assembly	Qualified Person	Not addressed*	See 1037b. (1)
Shift (Daily)	Competent Person	No	1037c. (1) (a) to (n)
Monthly	Competent Person	Yes. Save 3 months	1037c. (1) (a) to (n)
Annual	Qualified Person	Yes. Save 12 months	1037c. + 1037e. (2)
Modifications	Qualified Person	Yes	1037 (1)
Repairs or Adjustments	Qualified Person	Not addressed*	1037a. (a) to (b)
Severe Service	Qualified Person	Not addressed*	1037f.

* Just because there is not a specific rule addressing documentation does not conclusively mean that documentation is not required. For some operations, it may be important to document these inspections in some way.
** This table is intended as an instructional aid. It is not a substitute for reading and understanding the rules in MIOSHA Construction Safety Standard Part 10: Cranes and Derricks.

Discussion Questions

1. Does a shift inspection happen before the shift or after shift?
2. What requires shutting down vs. keep operating?
3. If you do keep operating, how long before you should repair something?
4. How long do you think you should give an operator to do an inspection each day?
5. Should shift inspections be documented?
6. Should the crane have some sort of daily log to indicate hours crane was in service, number of critical lifts, who operated, all minor adjustments or repairs, etc.?

Wire Rope Inspections

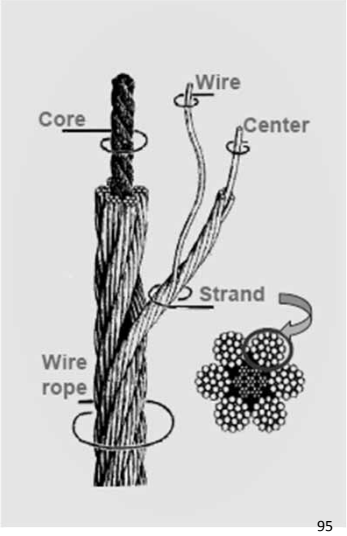
- The wire rope on the crane must be inspected.
- This is “above the hook” wire rope. Inspection of all rigging “below the hook” is addressed separately.
- In most cases, this inspection goes hand in hand with the crane inspection.
- OSHA and MIOSHA chose to write the rules for wire rope inspection separately from the rules for inspecting the rest of the crane.

Wire Rope is Used Two Ways on the Crane

- Standing (guy) rope: A supporting rope that maintains a constant distance between the points of attachment to the two components connected by the rope. (Also known as a pendant line.)
- Running rope: A rope that travels around sheaves and/or drums. It is let out and drawn back up.

Wire Rope Defined

- Wire rope means a flexible rope constructed by laying steel wires into various patterns of multi-wired strands around a core system to produce a helically wound rope.
- Wire rope is made of wires laid (not twisted) into a strand, with 6 or 8 strands laid around a fiber or wire rope center (core).



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Wire Rope Inspections Required

Type	Inspector Qualifications	Documented?	What to Inspect?
Post assembly			Inspection not addressed*
Shift (Daily)	Competent person	No	1038(1)
Monthly	Competent person	Yes	1038(1) + 1038b(3)(b)
Annual	Qualified person	Yes	1038(1), but cover entire surface of wire rope.
Modifications			Inspection not addressed*
Repair /adjust			Inspection not addressed*
Severe Service	Qualified Person	Not addressed	1038(1), assume entire surface of wire rope.

* You should assume that you must inspect the wire rope as part of the standard crane inspection, even though it does not specifically state it in the standard.

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Shift Wire Rope Inspections

- 1038 (1) Visually inspected by a competent person prior to each shift.
- Observing all rope, including **running** and **standing**, that can be expected to be in use during the day's operations.
- Purpose: To discover damage that may be an immediate hazard.
- Untwisting or opening of wire rope or booming down is not required as part of this inspection.

Monthly Wire Rope Inspections

- 1038a. (1) Each month an inspection shall be conducted in accordance with 1038.
  - 1038. = wire rope shift inspection.
- 1038a. (2) Include any deficiencies that must be monitored (due to the annual inspection).
- 1038a. (3) Wire rope not used until proper corrective action taken.
- 1038a. (4) The inspection shall be documented according to 1037d. (3) and (4).
  - 1037d. (3) and (4) = documentation for monthly crane inspection.

Annual Wire Rope Inspections

- 1038b. (1) At least every 12 months, by a qualified person, in accordance with 1038 (daily inspection requirements).
- 1038b. (2) (b) In addition, the inspection shall be complete and thorough, covering the entire length of the wire ropes. Particular attention to:
  - (i) Critical review items listed in 1038 (5).
  - (ii) Those sections that are normally hidden during shift and monthly inspections.
  - (iii) Wire rope subject to reverse bends.
  - (iv) Wire rope passing over sheaves.
- 1038b. (4) Documented according to 1037e. (7) (annual crane inspection).

Critical Review Items of Wire Rope

1038 (5) Give particular attention to all of the following:

- (a) Rotation resistant wire rope in use.
- (b) Wire rope being used for boom hoists and luffing hoists, particularly at reverse bends.
- (c) Wire rope at flange points, crossover points and repetitive pickup points on drums.
- (d) Wire rope at or near terminal ends.
- (e) Wire rope in contact with saddles, equalizer sheaves or other sheaves where rope travel is limited.

Rotation resistant wire rope

Categories of Deficiencies of Wire Rope

- Part 10 lists three categories of deficiencies in wire rope.
  - 1038 (2) Category 1
  - 1038 (3) Category 2
  - 1038 (4) Category 3
- The category of deficiency dictates the action that is required before using the crane.

Category 1 Deficiencies

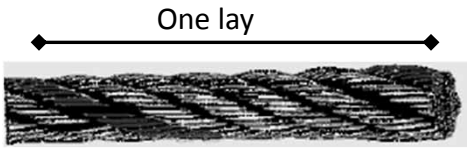
1038 (2) (a) Significant distortion of the rope, including:

- (i) Kinking.
- (ii) Crushing.
- (iii) Unstranding.
- (iv) Birdcaging.
- (vi) Signs of core failure or steel core protrusion between the outer strands.

- 1038 (2) (b) Electric arc damage.
- 1038 (2) (c) Improperly applied end connections.
- 1038 (2) (d) Significantly corroded, cracked, bent, or worn end connections, such as from severe service.

Categories 2 Deficiencies

- 1038 (3) (a) Broken or cut strands.
- 1038 (3) (b) In running wire ropes, 6 randomly distributed broken wires in 1 rope lay or 3 broken wires in 1 strand in 1 rope lay.
- 1038 (3) (c) In rotation-resistant ropes, 2 randomly distributed broken wires in 6 rope diameters or 4 randomly distributed broken wires in 30 rope diameters.
- 1038 (3) (d) In standing ropes, more than 2 broken wires in 1 rope lay in sections beyond end connections or more than 1 broken wire at an end connection.
- 1013a(4)(e) A diameter reduction of more than 5%.



Categories 3 Deficiencies

- 1038 (4) (a) In rotation resistant wire rope, core protrusion or other distortion indicating core failure.
- 1038 (4) (b) Prior electrical contact with a power line.
- 1038 (4) (c) A broken strand.

If Any Deficiencies are Found

- Refer to the category of deficiency. Proceed according to:

Category of Deficiency	Action Necessary
1	1038 (6) (a)
2	1038 (6) (b)
3	1038 (6) (c)

- Also, 1038 (6) (d) applies to all three: Where a wire rope is required to be removed from service under this rule, either the equipment as a whole or the hoist with that wire rope shall be tagged-out, in accordance with 1053b (1), until the wire rope is repaired or replaced.

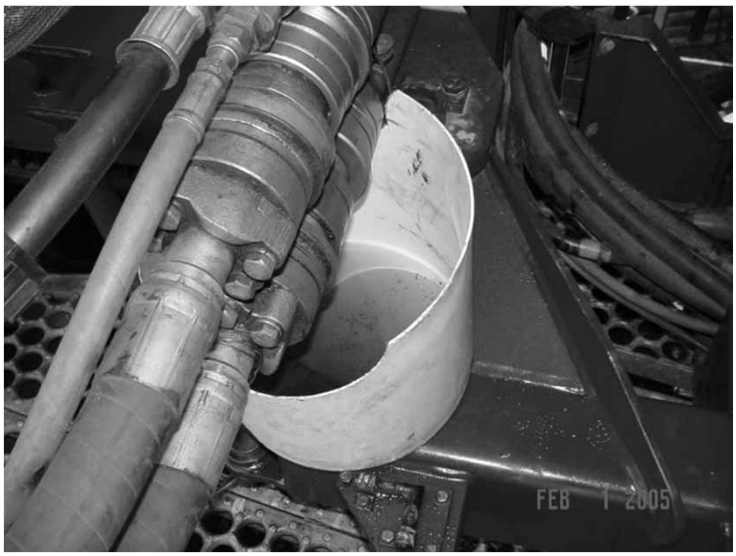
Wire Rope Deficiencies

Category 1	Category 2	Category 3
1038 (2) Significant distortion. Kinking. Crushing. Unstranding. Birdcaging. Main strand displacement. Signs of core failure or steel core protrusion between the outer strands. Electric arc damage. Improperly applied end connections. Significantly corroded, cracked, bent, or worn end connections, such as from severe service.	1038 (3) Broken or cut strands. Running rope: 6 random broken wires in 1 lay or 3 broken wires in 1 strand in 1 rope lay Rotation-resistant ropes, 2 random broken wires in 6 rope diameters or 4 random broken wires in 30 rope diameters. Standing ropes, more than 2 broken wires in 1 rope lay in sections beyond end connections or more than 1 broken wire at an end connection. A diameter reduction of more than 5%.	1038 (4) Rotation resistant rope: core protrusion or other distortion indicating core failure. Prior electrical contact with a power line. A broken strand.
Action: 1038 (6) (a)	Action: 1038 (6) (b)	Action: 1038 (6) (c)

Activity 4: Let's Play the Inspection Game!

- Raise your hand if you can spot what's wrong in the picture.
- For the bonus point, raise your hand to give the MIOSHA rule number.
- To make it more fun, some items may not have anything wrong.

What's Wrong?

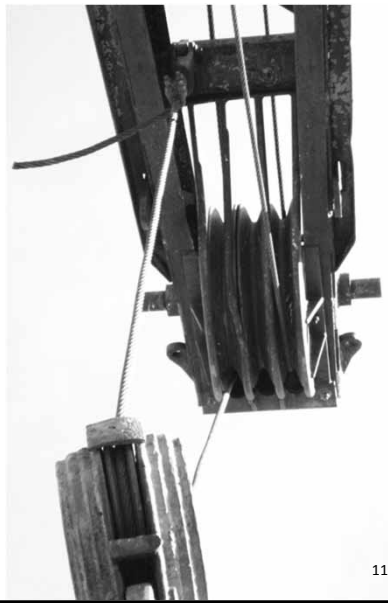


That's What's Wrong!

- Leaking hydraulics.

What's Wrong?

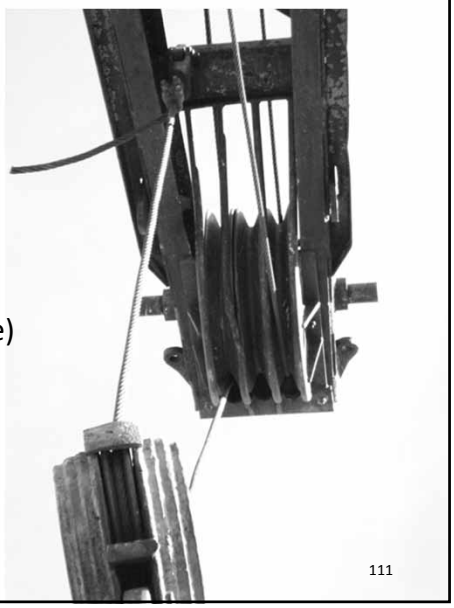
(Same crane in both pictures.)



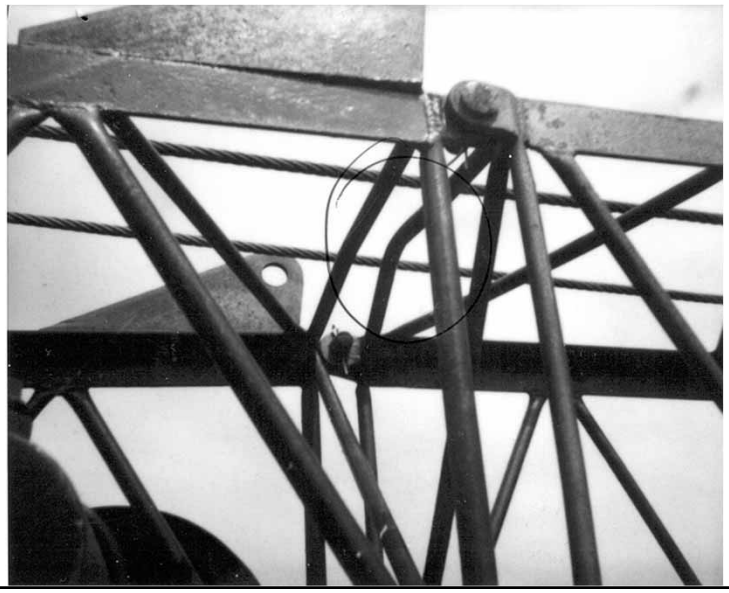
That's What's Wrong!

- Wire rope too small of diameter for sheave.
- Probably also either reeved wrong or terminated wrong.

(Same crane)

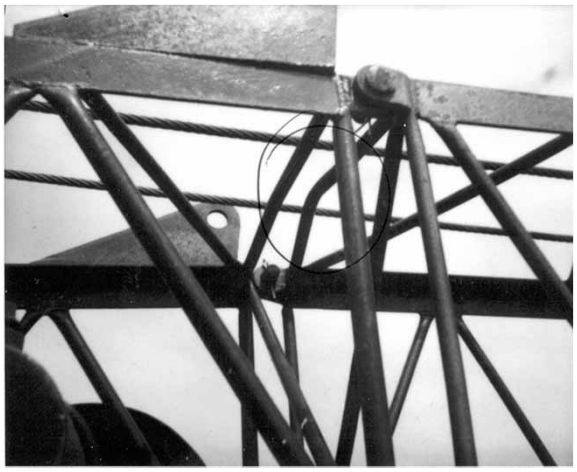


What's Wrong?



That's What's Wrong?

- Bent lattice.



What's Wrong?

That's What's Wrong!

- Only two outriggers extended.
- On sidewalk without any mats under outrigger pads.

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What's Wrong?

116

That's What's Wrong!

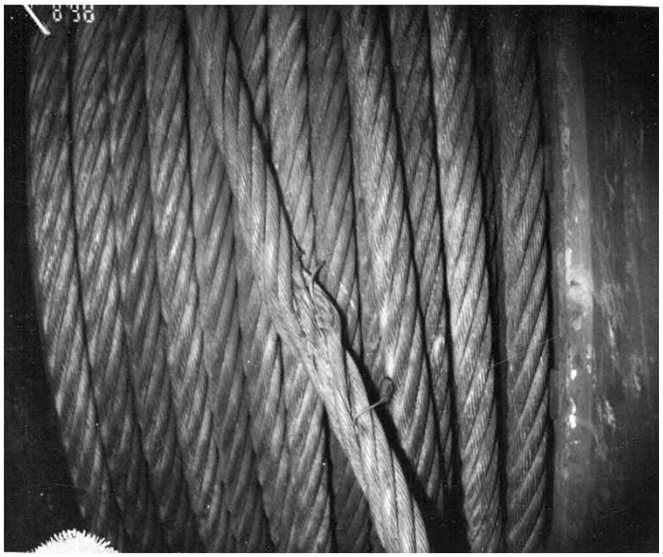
- Too many broken wires.

What's Wrong?

That's What's Wrong!

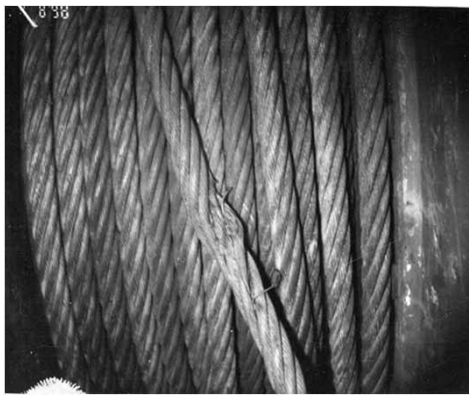
- Bad cribbing.

What's Wrong?



That's What's Wrong!

- Wire rope severely damaged.



What's Wrong?

That's What's Wrong!

- Outriggers in soft dirt conditions with no mats.

123

What's Wrong?

124

That's What's Wrong!

- Does he really need to be standing under that load?

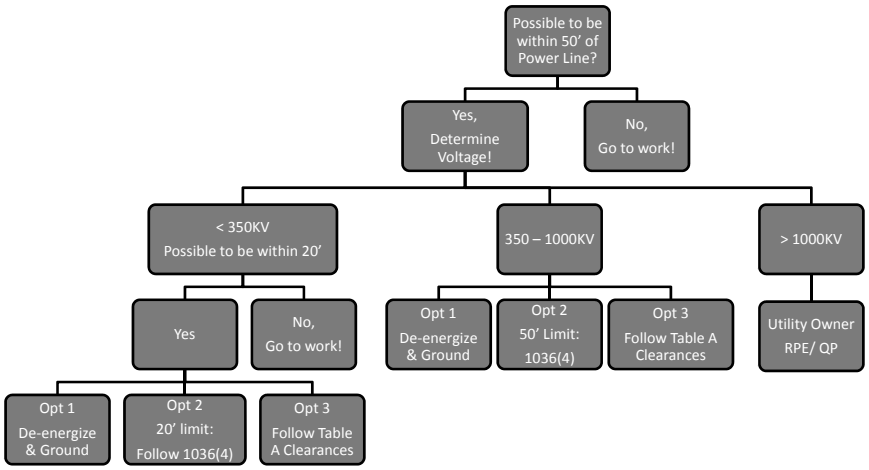
Lunch Break

Module Four: Power Line Safety

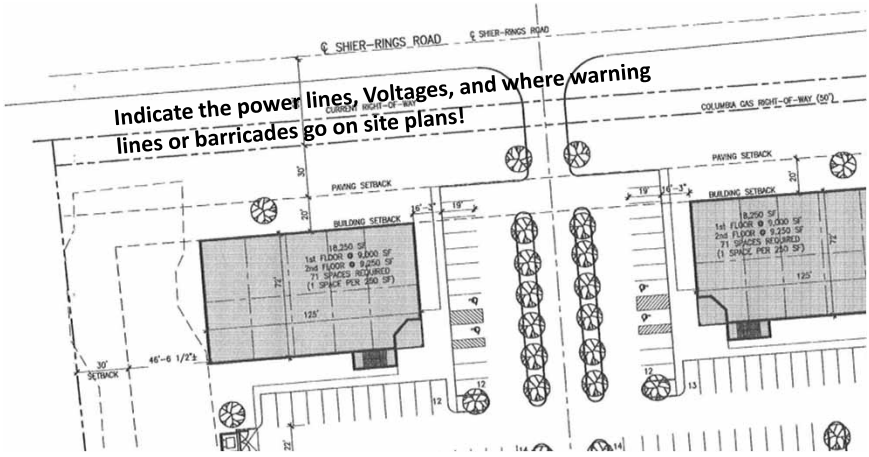
How far away from the power line is this crane's load line?

Now can you better estimate how far away the load line is from the power line?

Power Line Safety



Site Plan



Indicate the power lines, Voltages, and where warning lines or barricades go on site plans!

http://www.dublin.oh.us/planning/projects/08-001/index.php

Power Line Safety

Assembly/ Disassembly: "could" = 360 degrees

1036 (1), Before assembling/disassembling, determine if any part of the equipment, load line, or load, including rigging and lifting accessories, could get closer than 20 feet to a power line. If this could occur, the employer shall meet the requirements in 1 of the following: (Options 1, 2, and 3)

In other words, if you boomed all the way out, swung all the way around, is it possible to get closer than 20'? If so, then you must choose one of the 3 options for precautions.

Power Line Safety

Operations: Establish Work Zone Boundaries, or call it 360 degrees.

1036a. (1) Hazard assessments and precautions inside the work zone. Before beginning operations, the employer shall comply with the requirements in subrules (2) and (3) of this rule.

1036a. (2) The employer shall ensure that the work zone is identified by either of the following means:

(a) Demarcating boundaries such as with flags, or a device such as a range limiting device or range control device, and prohibiting the operator from operating the equipment past those boundaries.

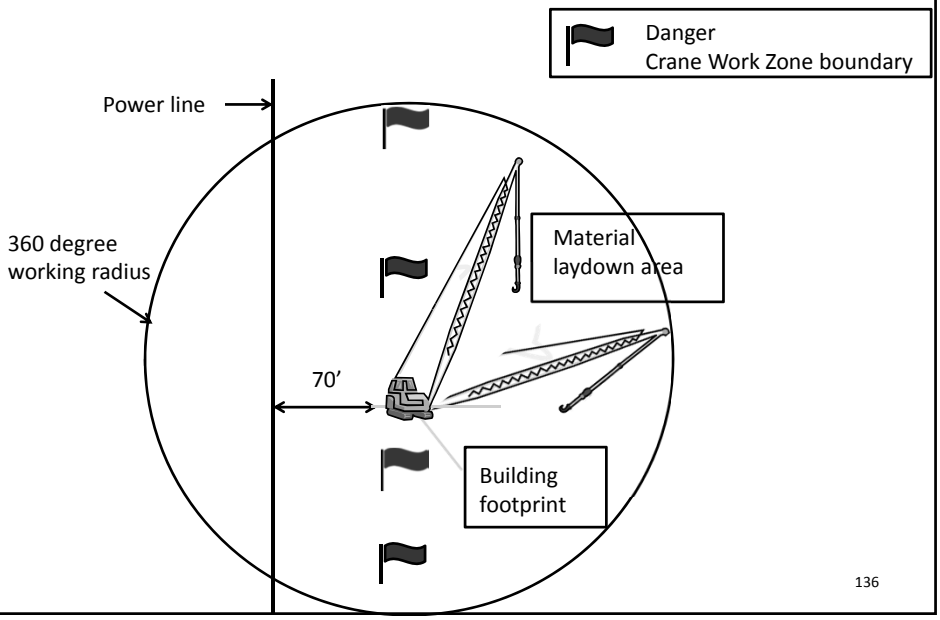
(b) Defining the work zone as the area 360 degrees around the equipment, up to the equipment's maximum working radius.

1036a. (3) Determine if any part of the equipment, load line, or load, including rigging and lifting accessories, if operated up to the equipment's maximum working radius **in the work zone**, could get closer than 20 feet to a power line. If this could occur, the employer shall meet the requirements in 1 of the following: (Options 1, 2, and 3)

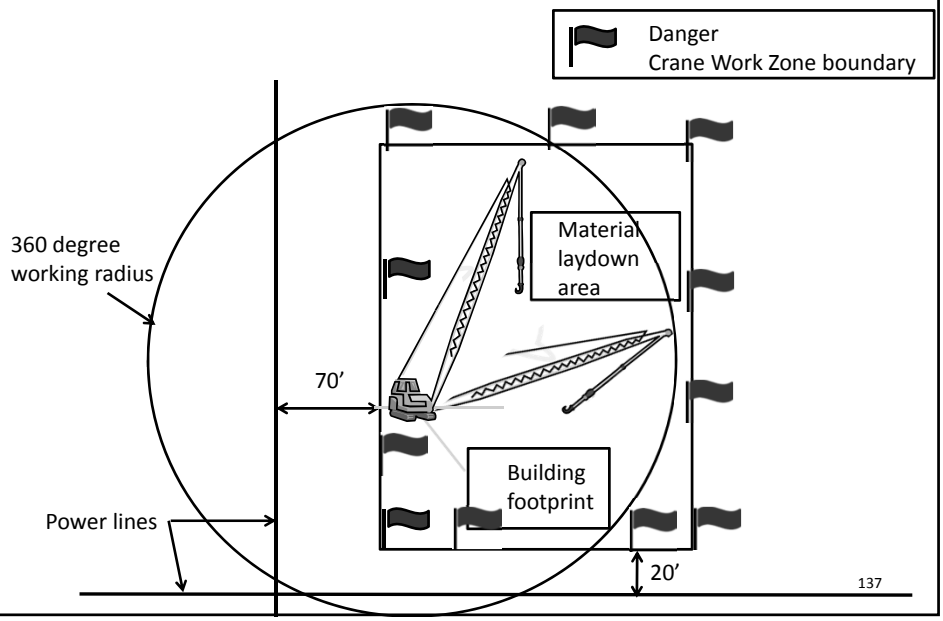
Work Zone Boundaries

- In other words, if you clearly mark your work zone boundaries, and if the power lines are more than 20’ from the boundaries, then you are good. Just maintain the boundary.
- Note the language: 1036a. (2) (a)“such as with flags, or a device such as a range limit device or range control warning device, and prohibiting the operator from operating the equipment past those boundaries.”
  - Expectation is that it is clearly evident where the boundaries are located and that the operator can clearly see these boundary markers.
  - Simplest would be one straight line of flags. Lots of powerlines might require a complete perimeter around your jobsite.

Sample Work Zone Boundary: Single Powerline



Sample Work Zone Boundary: Complete Perimeter



Power Line Safety:

1036a. (3) Determine if any part of the equipment, load line, or load, including rigging and lifting accessories, if operated up to the equipment's maximum working radius **in the work zone**, could get closer than 20 feet to a power line. If this could occur, the employer shall meet the requirements in 1 of the following:

Requirement Options	Employer Responsibilities
Option 1: 1036 (3)(a) De-energize and Ground	Confirm with the utility owner that the power line has been de-energized, and visibly grounded and worksite.
Option 2: 1036 (3)(b) 20 foot clearance *50 foot if over 350 KV*	Ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet to the power line by implementing the measures specified in subrule (4) of this rule (Encroachment prevention measures).
Option 3: 1036 (3)(c) Table A clearance	(a) Determine the line's voltage and the minimum clearance permitted under Table A "minimum clearance". (b) Determine if any part of the equipment, load line, or load, including rigging and lifting accessories, could get closer than the minimum clearance distance to the power line permitted under Table A. If this could occur, then you shall follow the requirements in subrule (4) of this rule.

TABLE A—MINIMUM CLEARANCE DISTANCES

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
up to 50	10
over 50 to 200	15
over 200 to 350	20
over 350 to 500	25
over 500 to 750	35
over 750 to 1,000	45
over 1,000	(as established by the utility owner or operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Note: The value that follows "to" is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

1036 (5) Encroachment Prevention Measures "Subrule 4" for Options 2 and 3

A/D 1036 (5)	Operations 1036a (4)
(a) Planning Meeting	(a) Planning Meeting
(b) Non-Conductive Tag Line	(b) Non-conductive Tag Line
(c) At least one of the following: • dedicated spotter, • proximity alarm, • range control warning, • Range limiting device, • elevated warning line, barricade, or line of signs in view of the operator.	(c) Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator (Spotter needed if out of view), equipped with flags or similar high-visibility markings, at 20 feet or applicable clearance from Table A.
	(d) At least one of the following: • proximity alarm • dedicated spotter • range control warning, • Range "slew" limiting device, • Insulating link.

Power Line Safety

1036 (4) (e) The requirements of subrule (4)(d) (encroachment prevention measures) of this rule do not apply to work covered by construction safety standard Part 16 “Power Transmission and Distribution.”

“Non-Conductive Tag lines”

WARNING: It is important to remember that all ropes, regardless of features or treatments, lose dielectric properties with use. Ropes that are ***wet*** or become ***dirty*** will conduct electricity.

-By: Chris Parrish, New England Ropes

1006c (13) "Nonconductive" means that, because of the nature and condition of the materials used, and the conditions of use, including environmental conditions and condition of the material, the object in question has the property of not becoming energized, that is, it has high dielectric properties offering a high resistance to the passage of current under the conditions of use.

Power Line Safety

- 1036 (7) Assembly or disassembly inside Table A clearance shall be prohibited.
- 1036 (8) Voltage information. When Option (3) of subrule (4) of this rule is used, the utility owner or operator of the power lines shall provide the requested voltage information within 2 working days of the employer's request.
- 1036 (9) Power lines presumed energized.

Power Line Safety

1036 (10) Posting of electrocution warnings. At least 1 electrocution hazard warning shall be conspicuously posted in the cab so that it is in view of the operator and, except for overhead gantry and tower cranes, at least 2 on the outside of the equipment.

Power Line Safety: Working Below Powerlines

During operations…

1036 (6) No part of the equipment, load line, or load, including rigging and lifting accessories, is allowed below a power line unless the employer has confirmed that the utility owner or operator has de-energized and visibly grounded the power line at the worksite.

Unless…

1036 (6) (b) and (c) the uppermost part of the equipment when extended/boomed all the way up would be more than 20’ (or table A clearance) from the powerline.

OR

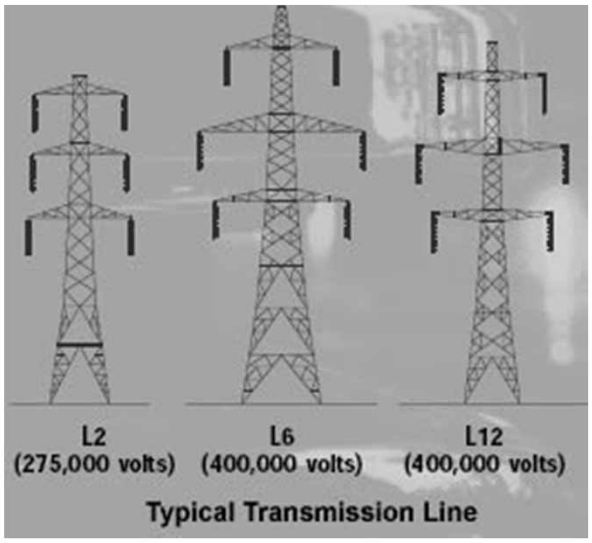
1036 (6) (d) the employer demonstrates that compliance with this subrule is infeasible and meets the requirements of 1036c.

Power Line Safety

Conclusion:

Determine the voltage of power lines.

- Use work-zone boundaries.
- Or, De-energize.
- Or, Option 2
- Or, Option 3 and follow Table A.



National Grid.com

Power Line Safety

1036d: traveling under the Power Lines with no load; must use a spotter

TABLE T—
MINIMUM CLEARANCE DISTANCES WHILE TRAVELING WITH NO LOAD

Voltage (nominal, kV, alternating current)	While traveling—minimum clearance distance (feet)
Up to 0.75	4
Over .75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1,000	20
Over 1,000	(as established by the utility owner or operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Working Closer Than Permitted? Not Allowed! Except…

1036c (2) The employer determines that it is infeasible to do the work without breaching the minimum approach distance under Table A.

(b)The employer determines that, after consultation with the utility owner or operator, it is infeasible to de-energize and ground the power line or relocate the power line.

All of the following is REQUIRED:

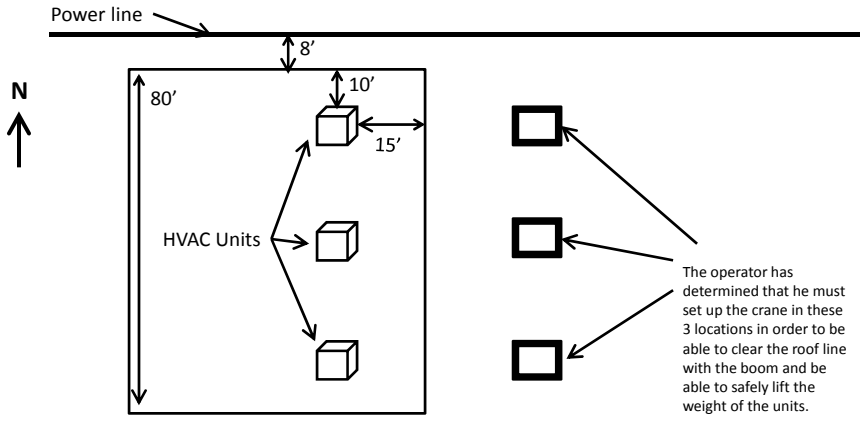
- Power Line Owner or registered professional engineer – Sets Minimum Approach Distance
- Planning Meeting – Procedures
- Dedicated Spotter
- Elevated Warning Line or Barricade
- Insulating Link/Device
- Nonconductive Rigging
- Range Limiter (if Equipped)
- Nonconductive Tag Line (if used)
- Barricades - 10 feet from Equipment
- Limit Access to Essential Employees
- Ground the Crane
- Deactivate Automatic Re-energizer

Activity 4: Working Safely Around Power lines

- Small groups will work on a scenario.
- Review the assigned scenario and determine what is necessary for you to work safely in regards to the power lines.
- Be prepared to present your ideas and possible solutions to the class.

Activity 4: Power line Safety Scenario 1

- You brought your 80 ton Grove rough-terrain crane to an industrial building in order to remove the old HVAC units off the roof and install the new HVAC units on the roof. Fully extended, it has 140' of boom.
- Prior to arrival, you asked the facility owner if there were any overhead power lines in the vicinity. She told you there was a power line running along the North side of the building, about 8' from the edge of the building. You called and found that it was a 15kv line.



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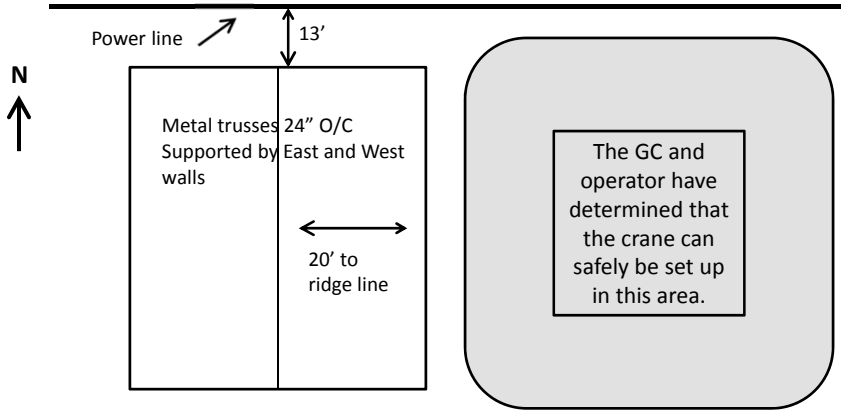
Activity 4: Power line Safety Scenario 2

- You brought your 110 ton Terex truck mounted crane to an 2 story building site to install trusses that weigh 1000 lb. Fully extended, it has 164' of boom. The ridge line runs North/South and is 46' high.
- Prior to arrival, your estimator observed power lines on the North Side of the building. They appear to be pretty big lines 13 horizontal feet from the edge of the building. You called the utility and find out they are 138 KV lines, 80' high.



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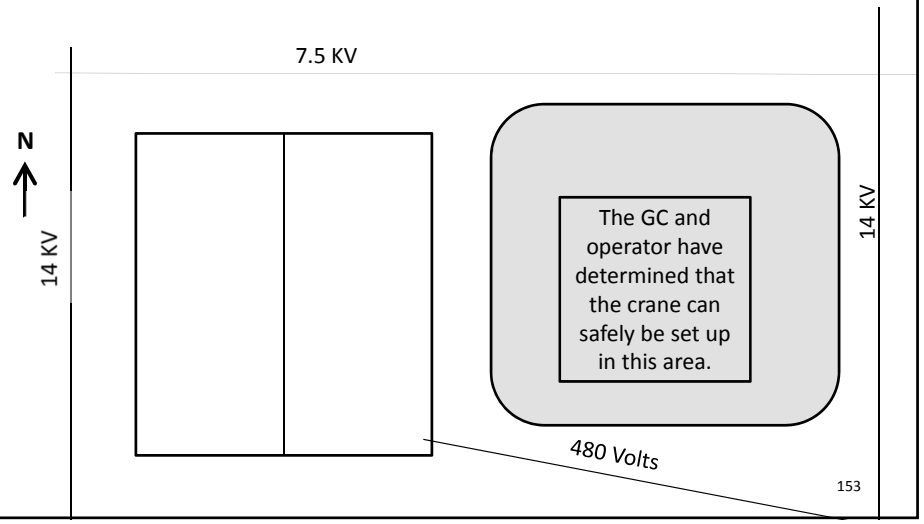
Activity 4: Power line Safety Scenario 3

- You brought your 110 ton Terex truck mounted crane to a job site that 12 feet high when traveling.
- Prior to arrival, your estimator observed power lines completely surrounding the building on the job site. They appear to be distribution lines on all four sides and measured 18’ high from the ground, except the service line to the building that is 15 feet.



Module Five: Operations

Fall Zone
Miami - March 25, 2008

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Fall Zone
Miami - March 25, 2008

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Ground Conditions
Grand Rapids – March 27, 2009

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What is Wrong Here?

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Riding the Load

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Wind

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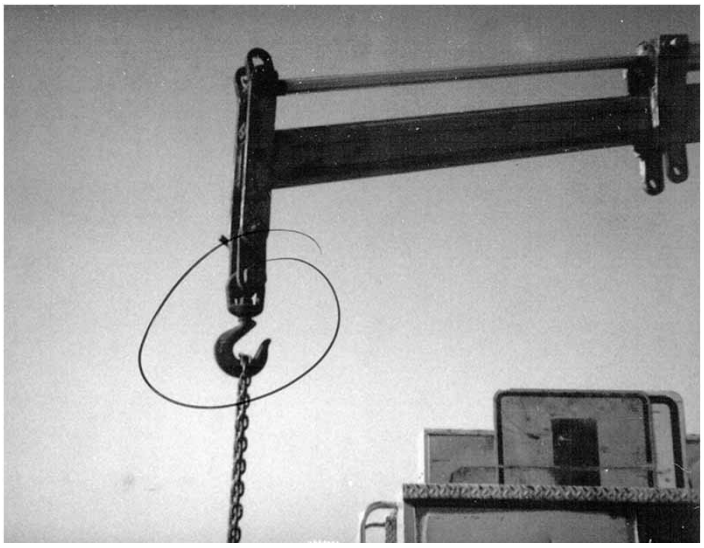
Open Hooks



Falls

Joe Woolhead/Associated Press photo

Swinging Counterweights

Struck By a Load
APRIL 30, 2008

Employee was removing excess, cured in place pipe within a manhole. The employees score cut a section of material, tied an approximately 40 foot long rope to one end of the material, and attached the other end of the rope to a hook of a boom truck crane. The crane was used to put the material under tension. The material suddenly released, fatally striking the worker. Happened in Wayne County.

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Citations Issued

General Rules

- Failure to provide training on release of stored energy.

Part 10: Cranes and Derricks

- Failure to ascertain weight of load prior to hoisting.
- Failure to ensure operator has knowledge and capability to operate crane.
- Operator Training.

Operations: Safety Concerns

- Lack of operator training due to the many crane types
- Using the wrong crane for the job
- Not understanding load charts and crane limitations
- Not checking for proper foundation and ground support
- Multiple contractors utilizing the same crane
- Multiple lift jobs [i.e., more than one crane/piece of equipment]

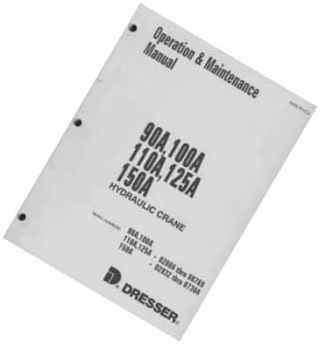
Operations

1053. (1)The employer shall comply with all manufacturer procedures applicable to the operational functions of equipment, including its use with attachments.

(2), (a),(b), and(c) When the manufacturer procedures are unavailable, the employer shall develop and ensure compliance with all procedures necessary for the safe operation of the equipment and attachments; operator controls (QP), and capacities of equipment (RPE).

Operations

1053. (3)(a)The procedures applicable to the operation of the equipment,… **shall be readily available in the cab** at all times for use by the operator.

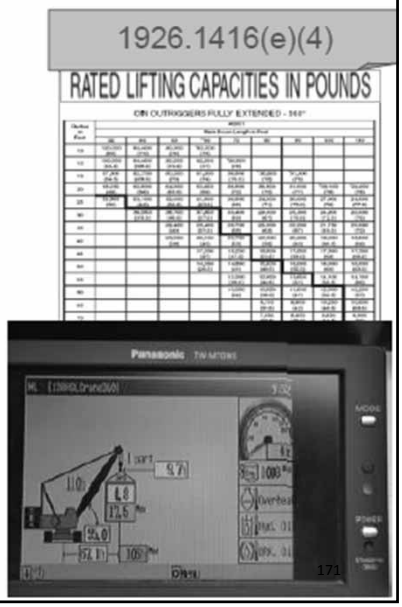


(b) When rated capacities are available in the cab only in electronic form and in the event of a failure that makes the rated capacities inaccessible, the operator shall immediately cease operations or follow safe shut-down procedures until the rated capacities, in electronic or other form, are available.

Rated Load Capacity and Devices

Load moment indicator (LMI) means a system which aids the operator by sensing the overturning moment on the equipment, (i.e., load multiplied by radius).

It compares this lifting condition to the equipment's rated capacity, and indicates to themoperator the percentage of capacity at which the equipment is working.



Critical Lift

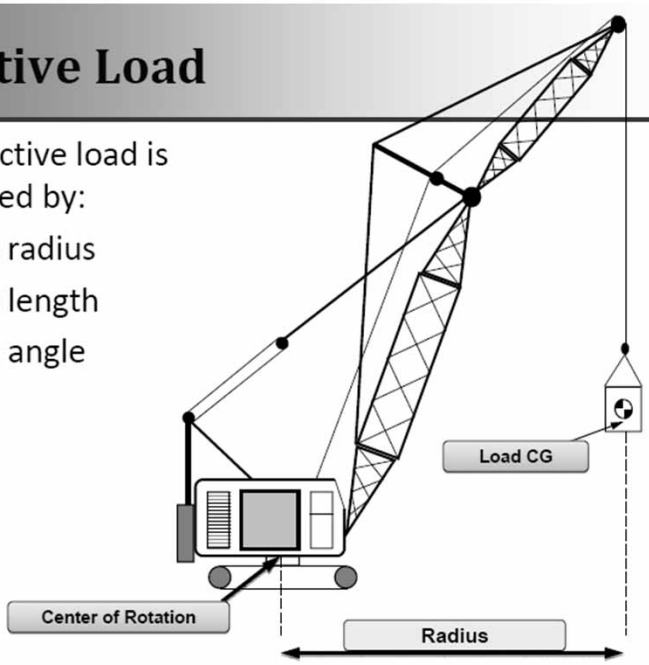
2604(15) "Critical lift" means a lift that exceeds 75% of the rated capacity of the crane or derrick or that requires the use of more than 1 crane or derrick.

ASME B30.5Definitions - Critical lift: A hoisting or lifting operation which has been determined to present an increased level of risk beyond normal lifting activities. For example, increased risk may relate to personnel injury, damage to property, interruption of plant production, delays in schedule, release of hazards to the environment, or other jobsite factors.

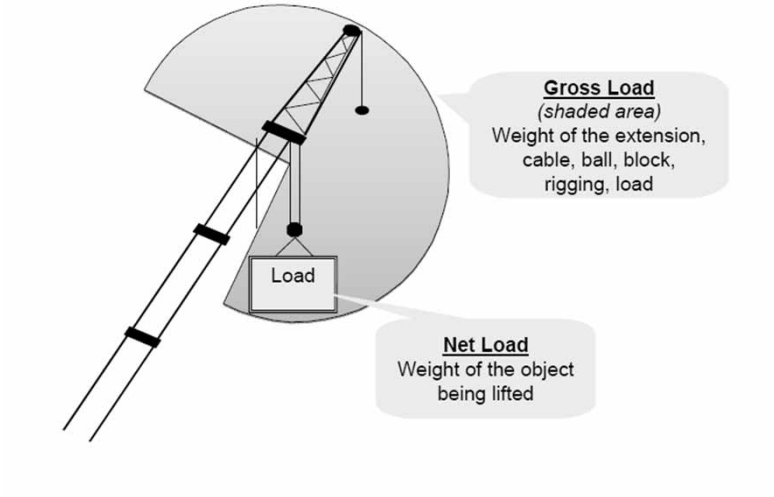
Effective Load

The effective load is affected by:

- Crane radius
- Boom length
- Boom angle



Gross vs. Net Load



Effective Load

Effective weight of attachments (used to calculated the gross load) may be more or less than actual weight of that attachment.

WEIGHT REDUCTIONS FOR LOAD HANDLING DEVICES

32 ft. Extension with 35 ft.- 110 ft. Boom	
*Stowed -	671 lbs.
*Erected -	4,149 lbs.

32 ft. - 56 ft. Tele. Ext. with 35 ft.- 110 ft. Boom	
*Stowed -	846 lbs.
*Erected (ret.) -	6,368 lbs.
*Erected (ext.) -	8,287 lbs.

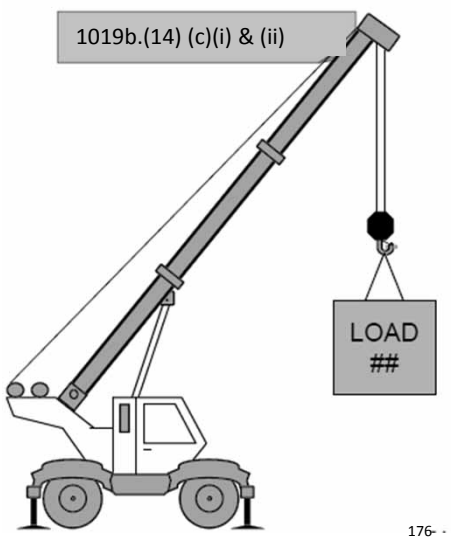
*Reduction of main boom capacities

HOOKBLOCKS:	
15 Ton, 1 Sheave	380 lbs.
30 Ton, 2 Sheave	843 lbs.
40 Ton, 4 Sheave	910 lbs.
40 Ton, 4 Sheave(w/cheek plates)	1100 lbs.
45 Ton, 3 Sheave	895 lbs.
45 Ton, 3 Sheave(w/cheek plates)	1095 lbs.
Auxiliary Boom Nose	143 lbs.
10 Ton Headache Ball	560 lbs.
7 1/2 Ton Headache Ball	336 lbs.

Net Load Weight

The weight of the net load must be determined from a source recognized by the industry or by a calculation method recognized by the Industry.

This information must be provided to the operator prior to the lift.



Load Chart

- Specific details on calculating the weight of crane components and set up for a safe lift are found in the load chart data.
- The rated capacity on a load chart is determined by the manufacturer.
- Capacities on the load chart are indicated as strength of materials (structural) or tipping (stability) capacities.

A bold or solid line is used to divide structural from stability capacities. All capacities above the bold line are structural capacities.

Tipping capacities

Radius		Boom	Length	
in Feet	36	49	62	75
12	160,000	103,000		
15	120,000	100,000	81,000	76,500
20	93,000	90,000	79,000	68,000
25	70,000	70,000	70,000	64,000
30	55,000	55,000	55,000	50,000

Calculating Gross Load Can Be Complex

Must know:

1. Correct configuration of the crane
2. Weight of line(s), block(s) or ball(s)
3. Weight of rigging
4. Effective weight of any attachments
5. Weight of object being lifted
6. Angle of boom
7. Length of boom
8. How to read the load chart and accompanying notes to properly add and subtract all the above.

BRODERSON RT300-2BO
LIFTING NOTES

1. Outriggers must be fully extended outward to use the outriggers out and down capacities.
2. The "On Outrigger" capacities of this crane are based on all outriggers being extended to a firm, level surface with all tires off ground.
3. Do not position boom at load radii where no load capacities are shown.
4. The weights of the hooks, blocks, overhaul weights, slings, and other handling devices must be added with the load.
5. Verified weights and measured radii must take precedence over the rated capacity limiter readings.
6. Maximum hydraulic pressure = 3000 psi
7. Tire pressure is 100 psi for 17.5-25 20PR tires
8. If the desired load radius falls between two load radii on the chart, it is recommended to use the load radius with lower capacity and not try to interpolate between the numbers.
9. Do not operate the crane at a load radius where no capacity is listed on the chart. Even an empty boom may tip the crane on rubber if it is extended over the side past 44 feet.
10. The capacities shown in the "360° rotation" columns of the capacity chart apply to the entire 360 degree rotation of the boom and are maximum allowable at the indicated radius. The capacities "Over Front" are limited to the following:
    a. On outriggers – Boom rotation is limited to an arc not to exceed the eight-foot wide front outrigger housing.
    b. On rubber operations, including pick and carry, are limited to the boom centered over front, in line with the chassis.
11. Pick and carry operation: Traveling with suspended loads involves so many variables, such as ground conditions, boom length, momentum in starting and stopping, that it is impossible to devise a single standard rating procedure with any assurance of safety. For such operations, the user must evaluate prevailing conditions and determine safe practices using precautions, such as the following:
    a. The boom should be centered over front axle.
    b. Do not pick and carry with boom extension.
    c. Use shortest boom practical.
    d. Reduce travel speed to suit conditions (3 mph max).
    e. Maintain specified tire pressures.
    f. Pick and carry on rubber capacities are for smooth, level paved surface.
    g. For unpaved surface, reduce capacity by 25%.

BRODERSON RT300-2BO
CAPACITY CHART

CAPACITIES APPLY TO OPERATION ON FIRM LEVEL SURFACE

	LOAD RADIUS	MAIN BOOM CAPACITIES IN POUNDS				
		360° ROTATION			OVER FRONT	
	FEET	ON RUBBER	O/R'S IN & DOWN	O/R'S OUT & DOWN	ON RUBBER	ON OUTRIGGERS
MAIN BOOM	10	18900	25500	30000	24900	30000
	12	15200	20800	28500	21400	28500
	14	11900	16000	25950	18100	25950
	16	8800	12600	22500	14300	22500
	18	7200	10300	19500	11800	19500
	20	5900	8500	17050	9700	17050
	22	4900	7100	15000	8200	15000
	24	4050	5900	13300	7000	13300
	26	3300	4900	11900	6000	11900
	28	2800	4100	10650	5100	10650
	30	2250	3500	9600	4400	9600
	32	1800	3000	8600	3800	8600
	34	1500	2600	8050	3400	8050
	36	1300	2200	7500	3000	7500
	38	1100	2000	6950	2700	6950
	40	1000	1800	6500	2500	6500
	44	700	1400	5700	2100	5700
	48		1100	5000	1700	5000
	52		900	4400	1400	4400
	56		700	4000	1150	4000
	60		500	3500	900	3500
BOOM EXTENSION	64			2700		2700
	68			2500		2500
	72			2400		2400
	76			2100		2100
	80			1900		1900

20 FOOT – BOOM EXTENSION CAPACITIES (lbs.)

BOOM EXTENSION OFFSET ANGLE	MAIN BOOM ANGLE						
	0°	15°	30°	40°	50°	60°	70°
0°	2300	2400	2700	3100	3700	4800	6200
15°	0	2300	2400	2600	2900	3400	4100
30°	0	0	2300	2400	2500	2700	3100

CAUTION: BOOM EXTENSION LOADS MUST NOT EXCEED MAIN BOOM CAPACITIES.

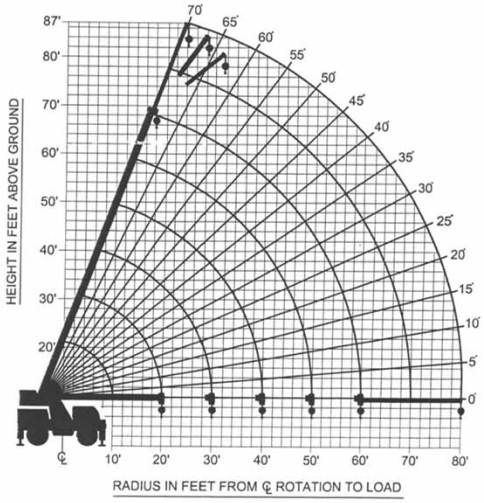
LOAD HOIST ROPE

½" – 6 x 25 XIP IWRC Rope – Minimum breaking strength of 26,600 lbs.	
Single Part Line for loads to 7,500 lbs.	Four Part Line for loads to 30,000 lbs.

DEDUCTIONS FOR LIFTING DEVICES

Overhaul Ball = 180 lbs.	Load Block = 440 lbs.
Boom Extension: Stowed on boom: 500 lbs. / Boom Extension Erected: 1000 lbs.	

BRODERSON RT300-2BO
RANGE DIAGRAM
WITH/OUT & DOWN OUTRIGGERS



Would You Get This Right?

What is the net capacity lifting from the main boom at a 37 foot radius 360 degrees?

- Outriggers: out and down
- Counterweight: Full
- Tires: 17.5-25 20 PR
- Main boom length: 60’
- Main boom angle: 47 degrees
- Ext. length: 20’ stowed
- Ext. angle: 0 degrees
- Block: N/A
- Headache Ball: 180 lb.
- Rigging: 150 lb.
- Wire rope main: ½” – 6x25 XIP IWRC
- Wire rope Extension: N/A

Operations

1053d. (1) If equipment adjustments or repairs are necessary both of the following shall be done:

- (a) The operator shall, in writing, promptly inform the person designated by the employer to receive such information and, where there are successive shifts, to the next operator.
- (b) The employer shall notify all affected employees, at the beginning of each shift, of the necessary adjustments or repairs and all alternative measures.

1053d (4) The competent person shall adjust the equipment, or operations, or both, to address the effect of wind, ice, and snow on equipment stability and rated capacity.

Big Blue Big Decisions

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Operations

- 1053e. (1) The equipment shall not be operated in excess of its rated capacity.
- (3) The operator shall verify that the load is within the rated capacity.

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Operations

- 1053c. (2)The operator shall obey a stop or emergency stop signal, irrespective of who gives it.

EMERGENCY STOP – With both arms extended horizontally to the side, palms down, arms are swung back and forth.

Horizontal, Not vertical motion

Operations

1053g (2)

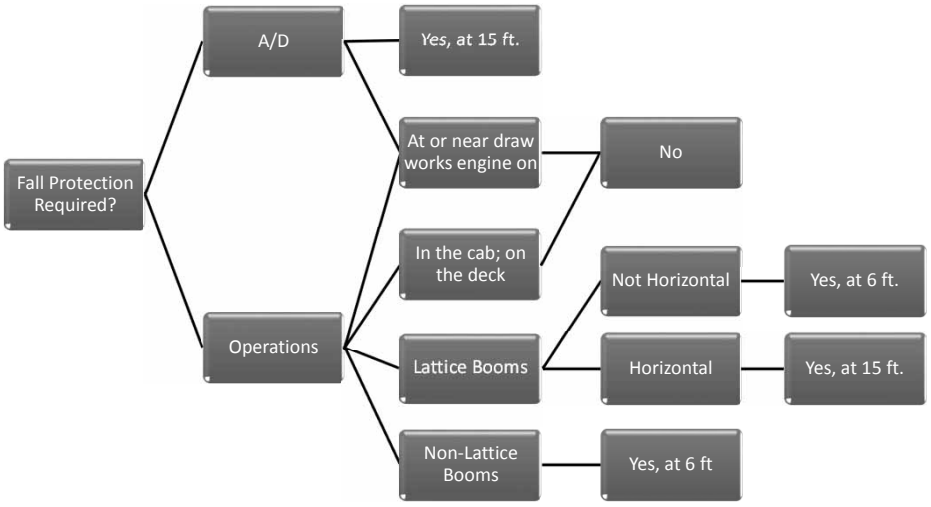
- (a)Equipment shall not be operated without the counterweight or ballast in place as specified by the manufacturer.

- (b)The maximum counterweight or ballast specified by the manufacturer for the equipment shall not be exceeded.

Authority to Stop Operation

1054. When there is a concern about safety, the operator may stop and refuse to handle loads until a qualified person has determined that safety has been assured.

Fall Protection



Fall Protection

1056h. Anchoring to the load line. A personal fall arrest system may be anchored to the crane or derrick's hook, or other part of the load line, where all of the following requirements are met:

- (a) A qualified person has determined that the set-up and rated capacity of the crane or derrick, including the hook, load line, and rigging, meets or exceeds the requirements in construction safety standard part 45 "Fall Protection," R 1926.502(d)(15), as referenced in R 408.41003e.
- (b) The equipment operator shall be at the work site and shall be informed that the equipment is being used for this purpose.
- (c) A load is not suspended from the load line when the personal fall arrest system is anchored to the crane or derrick's hook or other part of the load line.

1080 (2)
Hoisting Personnel is Prohibited…

Except where the employer demonstrates,

- that the erection, use, and dismantling of conventional means of reaching the work area, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform, or scaffold, would be more hazardous,
- or is not possible because of the project's structural design or worksite conditions.

Personnel Platforms

- 1080c. (1) Capacity: All charts are 50% ratings when hoisting personnel.
- 1080 d. (2) The system used to connect the personnel platform to the equipment must allow the platform to remain within 10 degrees of level, regardless of boom angle.
- 1080d. (1) A qualified personnel familiar with structural design shall design the personnel platform and/or suspension system.
- 1080f (3) Rigging …shall be capable of supporting, without failure, at least 5 times the maximum intended load; rotation resistant rope, then 10 times the maximum intended load.

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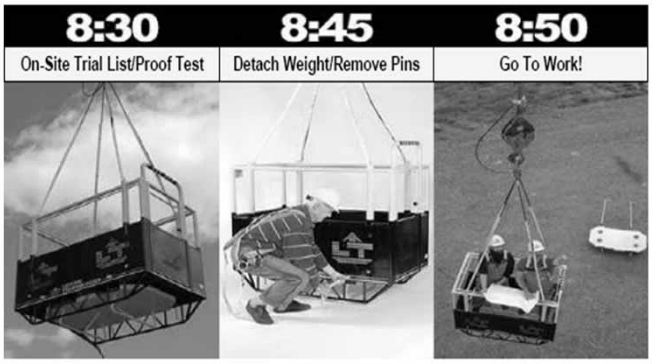
Hoisting Personnel

1080g. (2) Trial Lift and Inspection:

The trial lift shall be performed immediately before placing personnel on the platform.



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Work Area Control

1057 (2) To prevent employees from entering Swing Radius hazard areas, the employer shall do all of the following:

- (a) Train employees in how to recognize struck-by and pinch or crush hazards.
- (b) Erect and maintain control lines, warning lines, railings, or similar barriers to mark the boundaries.

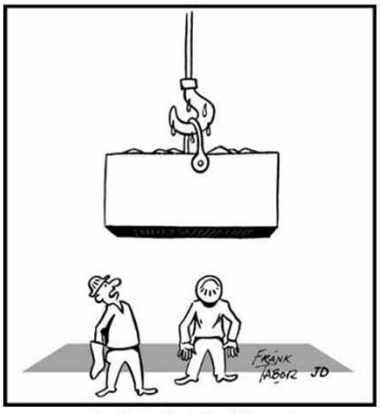
Swing Radius Safety: Exception

When the employer can demonstrate that it is neither feasible to erect such barriers on the ground nor on the equipment, the hazard areas shall be clearly marked by danger signs:

1058 Keeping Clear of the Load

- …An employee shall not within the fall zone of a suspended load, except:
  - Hooking, unhooking or guiding a load.
  - Initially attaching the load.
  - Operating a concrete hopper or concrete bucket.
  - Must use Qualified Rigger.
  - Must use closed hook (J hooks OK for wood trusses).

Definitions



Boy! Is that load heavy!
Look at the beads of sweat on that hook!

"Qualified rigger" means an individual who is a qualified person with specific training and experience demonstrating the ability to solve or resolve problems relating to rigging.

Definitions

"Qualified signal person" means an individual who is a qualified person with specific training and experience demonstrating the ability to solve or resolve problems relating to signaling.

"Signal system" means an audible or visual method of communication between the equipment operator and the persons on the landing or floors.

"Standard method" means the protocol in Appendix A of this standard for hand signals.

1055. Signals; general requirements.

1055 (1) A signal person shall be provided in each of the following situations:

- (a) The point of operation, meaning the load travel or the area **near or at load placement, is not in full view of the operator.**
- (b) When the equipment is traveling, the view in the direction of travel is obstructed.
- (c) Due to site **specific safety concerns**, either the operator or the person handling the load determines that it is necessary.

Signals; general requirements

- 1055 (2) Signals shall be by hand, voice, audible, or new signals.
- 1055 (3) (a) When using hand signals, the standard method shall be used.
- 1055 (8) Only 1 person shall give signals, except emergency stop.
- 1055 (10) Must use operator's direction perspective.
- 1055a (3) operator shall receive signals using a hands-free device.

APPENDIX A
Standard Hand Signals

STANDARD METHOD FOR HAND SIGNALS

STOP – With arm extended horizontally to the side, palm down, arm is swung back and forth.

EMERGENCY STOP – With both arms extended horizontally to the side, palms down, arms are swung back and forth.

HOIST – With upper arm extended to the side, forearm and index finger pointing straight up, hand and finger make small circles.

RAISE BOOM – With arm extended horizontally to the side, thumb points up with other fingers closed.

SWING – With arm extended horizontally, index finger points in direction that boom is to swing.

RETRACT TELESCOPING BOOM – With hands to the front at waist level, thumbs point at each other with other fingers closed.

RAISE THE BOOM AND LOWER THE LOAD – With arm extended horizontally to the side and thumb pointing up, fingers open and close while load movement is desired.

DOG EVERYTHING – Hands held together at waist level.

LOWER – With arm and index finger pointing down, hand and finger make small circles.

LOWER BOOM – With arm extended horizontally to the side, thumb points down with other fingers closed.

EXTEND TELESCOPING BOOM – With hands to the front at waist level, thumbs point outward with other fingers closed.

TRAVEL/TOWER TRAVEL – With all fingers pointing up, arm is extended horizontally out and back to make a pushing motion in the direction of travel.

STANDARD METHOD FOR HAND SIGNALS

LOWER THE BOOM AND RAISE THE LOAD – With arm extended horizontally to the side and thumb pointing down, fingers open and close while load movement is desired.

MOVE SLOWLY – A hand is placed in front of the hand that is giving the action signal.

USE AUXILIARY HOIST (whipline) – With arm bent at elbow and forearm vertical, elbow is tapped with other hand. Then regular signal is used to indicate desired action.

CRAWLER CRANE TRAVEL, BOTH TRACKS – Rotate fists around each other in front of body; direction of rotation away from body indicates travel forward; rotation towards body indicates travel backward.

USE MAIN HOIST – A hand taps on top of the head. Then regular signal is given to indicate desired action.

CRAWLER CRANE TRAVEL, ONE TRACK – Indicate track to be locked by raising fist on that side. Rotate other fist in front of body in direction that other track is to travel.

TROLLEY TRAVEL – With palm up, fingers closed and thumb pointing in direction of motion, hand is jerked horizontally in direction trolley is to travel.

Struck by falling load
June 22, 2009

- A load of roofing materials was hoisted by a tower crane to a staging area located on the same roof.
- Material became dislodged from a wooden pallet.
- Striking the worker located on the roof.
- Unsafe rigging, must use Qualified Rigger.
- Unsafe position, within the Fall Zone!

Struck by falling load

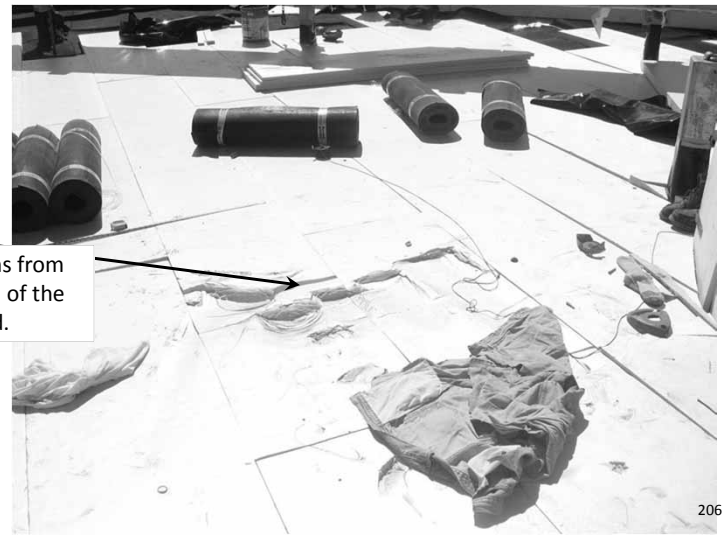
Note the deformation of the pallet.

Note the load leaning.

Struck by falling load

The crane operator is way up here and cannot easily see how objects are rigged.

Struck by falling load



The impressions from where one end of the bundles landed.

Module Six:
Training, Qualifications, and Certification

Training Objectives

This lesson will enable you to verify worksite personnel compliance regarding requirements for training and certification. Specifically, you'll be able to determine compliance of requirements regarding:

- Crane Operator certification
- Signal person qualifications
- Rigger personnel qualifications
- Service (maintenance/repair) qualifications
- Employee overhead powerline training
- Discuss questions to ask

Operator Qualification & Certification:

- 1061 (1) The employer shall ensure that the operator is qualified or certified to operate the equipment.

- 1061 (2)(a) Exceptions. Not required for operators of:
  - (a) Derricks. See 1085 to 1085h.
  - (b) Sideboom cranes. See 1089.
  - (c) Equipment with a maximum manufacturer-rated hoisting or lifting capacity of 2,000 pounds or less. See 1090 to 1090e.

Operator Qualification & Certification:

Three options to comply by 11/10/17

	Rule	How	Portable	Valid for
1	1061a	"Certification" by an accredited crane operator testing organization.	Yes	5 yrs
2	1061b	"Qualification" by an audited employer program.	No	5 yrs
3	1061c	"Licensing" by a government entity.	No	Up to 5 yrs

1061g (a) Phase-in period: The employer shall ensure that operators of equipment covered by this standard are competent to operate the equipment safely.

Operator Certification Criteria

1061f. (1) Qualifications and certifications shall be based, at a minimum, on both of the following:

- (2) A written test.
- (3) A practical test that the individual has the skills necessary for safe operation of the equipment.

Operator Certification Resources

- NCCCO (National Commission for the Certification of Crane Operators) website is a good place to start finding info on how to get your operators certified.

  www.nccco.org

Signal Person Qualifications:

1006d (12) “Qualified Signal Person” No specific definition given.

Refer to “qualified person” definition:

A person who, through attainment of a recognize degree or certificate of professional standing OR by extensive knowledge, training and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

Qualified Signal Person

1062 (1) The employer shall ensure that each signal person meets the qualification requirements in ***subrule (3)***. Met by using either:

- (a) Option (1) third-party qualified evaluator (with documentation).
- (b) Option (2) employer’s qualified evaluator. The employer’s qualified evaluator as defined in 1006d shall assess the individual and determine that he or she meets the qualification requirements in subrule (3) of this rule and provides documentation of that determination. Not portable.

Qualified Signal Person

1062 (c) The employer shall make the documentation for whichever option is used available at the site while the signal person is employed by the employer. The documentation shall specify each type of signaling, such as hand signals and radio signals, for which the signal person meets the requirements of ***subrule (3)*** of this rule.

Qualified Signal Person Requirements

1062 "***subrule (3)"*** Qualification requirements:

- (a) Know and understand the type of signals used. If hand signals are used, know the standard method for hand signals.
- (b) Be competent in the application of the type of signals used.
- (c) Have a basic understanding of equipment operation and limitations, including the crane dynamics involved in swinging and stopping loads and boom deflection from hoisting loads.
- (d) Know and understand the relevant requirements of 1055 to 1055c.
- (e) Demonstrate the requirements in subdivisions (a) to (d) of this rule through an oral or written test and a practical test.

Rigger Qualification

Two rules indicate need for a Qualified Rigger:

- **Assembly and Disassembly:** Rules: 1015a(2)(r) Rigging. In addition to following the requirements in Part 8 "Handling and Storage of Materials," as referenced in 1003a, and other requirements in this and other standards applicable to rigging, when rigging is used for assembly or disassembly, the employer shall ensure the rigging work is done by a qualified rigger.

- **Keeping Clear of the Load:** 1023a(3) When employees are engaged in hooking, unhooking, or guiding the load, or are in the initial connection of a load to a component or structure and are within the fall zone, all of the following criteria shall be met:
  - (c) The materials shall be rigged by a qualified rigger.

Rigger Qualification

- 1006d. (13) "Qualified rigger" means a rigger who meets the criteria for a qualified person.

- No specific training requirements outlined in the standard.
- No specific documentation requirements outlined in the standard.
- So how do you make a rigger a qualified rigger?
  - You still must train and designate riggers as qualified for the type of rigging they will perform.
  - You should document training of riggers.

Operators-In-Training

1061d (1) Training period. An employee who is not qualified or certified under this rule may operate equipment only as an operator-in-training. All of the following apply:

- (2) sufficient training prior to operating to enable the operator-in-training to operate safely under limitations.
- (3) The tasks performed shall be within the operator-in-training's ability.
- (4) Trainer. The operator-in-training shall be continuously monitored by an operator's trainer (some requirements for the trainer here).
- (5) Continuous monitoring by trainer.
- (6) The operator-in-training shall not operate in some circumstances such as near powerlines, hoisting personnel, multiple-equipment lifts, multi-lift rigging (Christmas-treeing), over cofferdams and shafts, or in tank farms.

Operator Training

Outside the Operator-in-training section, the standard includes a handful of specific items the employer must train operators and others on:

- 1064 (6) Train each operator in the following practices:
  - (a) How to determine if the boom hoist brake needs to be adjusted or repaired.
  - (b) Manufacturer's emergency procedures for halting unintended equipment movement.
  - (7) Train each competent person and each qualified person regarding the requirements of this standard applicable to their respective roles.
  - (8) Crush and pinch points. Train each employee who works with the equipment to keep clear of holes, and crush and pinch points.
  - (9) Tag-out procedures.

Employee Training

1036 (a) (9) Train each operator and crew member assigned to work with the equipment on all of the following:

- Procedures in the event of electrical contact
  - Danger of contacting equipment and ground at same time
  - Stay in cab, unless imminent danger of fire
  - Safe exit
  - Energized zone, step potential
  - Stay back from equipment, zone
  - Safe clearance distance from power lines
- Presumed energized
- Presumed un-insulated
- Limitations of insulating and limiting devices
- Limitations of grounding

Powerline Training

1036a (9)(f) Spotters shall be trained to enable them to effectively perform their task, including training on the applicable requirements of this rule.

Maintenance and Repair Personnel Qualifications

- 1063 (1) Maintenance, inspection, and repair personnel may operate the equipment only when the following are met:
- (a) Operation is limited to functions necessary to perform maintenance, inspection, or verify its performance.
- (b) The personnel either:
  - (i) Operate equipment under direct supervision of a qualified/certified operator OR
  - (ii) Are familiar with the operation, limitations, characteristics, and hazards associated with the type of equipment.
- 1063 (2) Maintenance and repair personnel shall meet the definition of a qualified person with respect to the equipment and maintenance or repair tasks performed.

Training:

Additional training requirements for:

- Fire extinguisher use
- Fall hazards
- Control lines, warning lines
- Equipment with rated capacity less than 2000 lbs.
- Excavating equipment
  - Capabilities, controls, daily inspections, practice in operating, state standards and company rules
- Avoiding rotating counterweights
- Material and material hoists

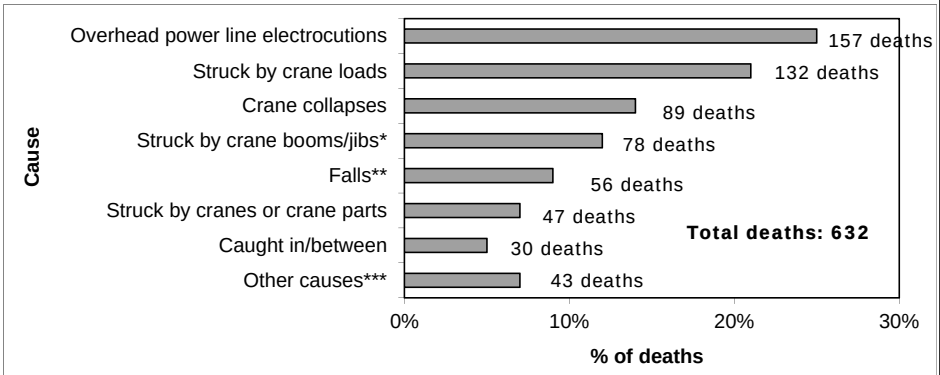
Training Summary

- EVERYBODY needs SOME training
- Operators: qualified/certified by 3 options
- Signal persons qualified by 3rd party or employer
- Rigger qualified
- Operators-in-training monitored by certified operator/trainer
- Powerline training for all affected
- Maintenance and repair personnel must be qualified persons

Module Eight

- Review & Important Things to Know
- Crane and Safety Resources
- Post Test

Causes of Crane-Related Deaths in Construction, 1992-2006



* Included 64 struck by falling booms/jibs
** Included 21 falls from cranes, 9 falls from crane baskets, 8 from crane loads.
***Other causes included 9 highway incidents.
Source: BLS CFOI data

Review Included/ Excluded

1001 (1) This standard applies to power operated equipment, when used in construction, that can hoist, lower, and horizontally move a suspended load.

Exclusions:

Digger Derrick, Aerial Work Platforms, Delivery Equipment, multi-function machines when not used with a hook or winch.

Review Ground Conditions

- Cracks in the asphalt/concrete paving? Have there been any new patches?
- Who evaluated the ground conditions?
- Is it firm and drained?
- Is crane set up on previously disturbed soil? Check for compaction.
- Over utilities or vaults or near new buildings?
- What type of soil is present?
- Does the crane operators manual give any direction for set up?
- The controlling entity shall ensure ground preparations necessary to meet the (ground condition) requirements, and inform the user of the equipment and the operator of the location of hazards beneath the equipment set-up area.

Review Assembly / Disassembly

- "A/D director" is both a "competent person" and a "qualified person."
- A/D Director is competent and qualified person who carries out manufacture's A/D procedures and must notify crew of their tasks, hazards associated with tasks, and any hazardous locations to avoid.
- All rigging work is done by a Qualified Rigger.
- When using outriggers - fully extend *or* deploy as per the load chart.
- Post Assembly Inspection.

Review Inspections

- Daily and monthly inspections by competent person.
- Annual inspections by qualified person.
- Inspect after assembly, modification, repair, severe service.
- Do not let the rules confuse you: if there is an unsafe condition present, you must get it fixed prior to operating that crane.

Review Types of Inspections**

WHEN	Inspector Qualifications	Documented?	What to Inspect?
Post Assembly	Qualified Person	Not addressed*	See 1037b. (1)
Shift (Daily)	Competent Person	No	1037c. (1) (a) to (n)
Monthly	Competent Person	Yes. Save 3 months	1037c. (1) (a) to (n)
Annual	Qualified Person	Yes. Save 12 months	1037c. + 1037e. (2)
Modifications	Qualified Person	Yes	1037 (1)
Repairs or Adjustments	Qualified Person	Not addressed*	1037a. (a) to (b)
Severe Service	Qualified Person	Not addressed*	1037f.

* Just because there is not a specific rule addressing documentation does not conclusively mean that documentation is not required. For some operations, it may be important to document these inspections in some way.

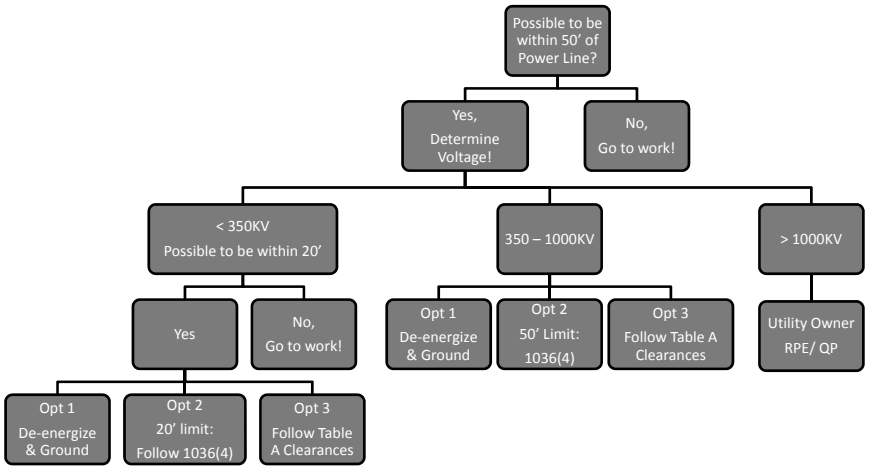
** This table is intended as an instructional aid. It is not a substitute for reading and understanding the rules in MIOSHA Construction Safety Standard Part 10: Cranes and Derricks.

Review Wire Rope Inspections Required

Type	Inspector Qualifications	Documented?	What to Inspect?
Post assembly			Inspection not addressed*
Shift (Daily)	Competent person	No	1038(1)
Monthly	Competent person	Yes	1038(1) + 1038b(3)(b)
Annual	Qualified person	Yes	1038(1), but cover entire surface of wire rope.
Modifications			Inspection not addressed*
Repair /adjust			Inspection not addressed*
Severe Service	Qualified Person	Not addressed	1038(1), assume entire surface of wire rope.

* You should assume that you must inspect the wire rope as part of the standard crane inspection, even though it does not specifically state it in the standard.

Review Power Line Safety



Review Power Line Safety:

1036a. (3) Determine if any part of the equipment, load line, or load, including rigging and lifting accessories, if operated up to the equipment's maximum working radius **in the work zone**, could get closer than 20 feet to a power line. If this could occur, the employer shall meet the requirements in 1 of the following:

Requirement Options	Employer Responsibilities
Option 1: 1036 (3)(a) De-energize and Ground	Confirm with the utility owner that the power line has been de-energized, and visibly grounded and worksite.
Option 2: 1036 (3)(b) 20 foot clearance *50 foot if over 350 KV*	Ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet to the power line by implementing the measures specified in subrule (4) of this rule (Encroachment prevention measures).
Option 3: 1036 (3)(c) Table A clearance	(a) Determine the line's voltage and the minimum clearance permitted under Table A "minimum clearance". (b) Determine if any part of the equipment, load line, or load, including rigging and lifting accessories, could get closer than the minimum clearance distance to the power line permitted under Table A. If this could occur, then you shall follow the requirements in subrule (4) of this rule.

Review Operations

- Manual, Load Charts, and 10 BC fire extinguisher in cab available to Operator.
- The Operator is responsible to verify that a load is within the rated capacity of the crane.
- Outriggers must be fully deployed or per manufacture.
- Adjust procedures for wind, ice and snow.
- The operator shall obey a stop or emergency stop signal, irrespective of who gives it.
- When there is a concern about safety, the operator may stop and refuse to handle loads until a qualified person has determined that safety has been assured.
- An employee shall not be permitted under a suspended load.
- Rotating Counterweights shall be barricaded to prevent struck by and crushed by hazards.

Review of Signals

- Only 1 signalperson at any one time.
- The signalperson AND operator must know the hand signals being used.
- The signalperson must be able to observe the load and other workmen at all times.
- The signalperson must always be in plain view of the crane operator.
- Signal Person's primary concern: watch the load!

Review of Training

- EVERYBODY needs SOME training.
- Operators: qualified/certified by 3 options.
- Signal persons qualified by 3rd party or employer.
- Rigger qualified.
- Power line training for all assigned to work with the equipment.
- Maintenance and repair personnel must be qualified persons.

Assessment

- The purpose of this assessment is to validate the knowledge learned in class.
- Passing score of 70% correct is required.
- Class reference materials/books are not allowed to be used during the assessment.
- Collaboration/discussion with others is not allowed during the assessment.
- Answers will be reviewed after everyone completes and submits their assessment.

Online Transcript

https://webadvisor.macomb.edu

What?

- Check individual courses – Proficient / Not Proficient
- Track courses taken through the MTI
- Request a transcript to show certification
- Manage account information

How?

- Select *What's My User ID?*
- Key in the Last Name and SS# or Macomb ID
- Select *Log In*
- If you need help call 586-498-4106 or email mti@macomb.edu

Thank You For Attending This Presentation

Michigan Occupational Safety & Health Administration
Consultation Education & Training Division
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Lansing, MI 48933

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MIOSHA
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Part 10. Cranes and Derricks

Student Resources

MIOSHA Standards:

Part 10. Cranes and Derricks

Compared to OSHA 1926 Sub Part CC

MIOSHA Fact Sheets:

Crane Operator Certification

Contractor's Directory to Overhead Power Line Safety

Highlights of the New Part 10 – Cranes and Derricks Standard

Other Resources:

Cranes Today

The Center for Construction and Research and Training

The National Commission for the Certification of Crane Operators

Vertikal

OSHA Cranes and Derricks Safety

Topping Out of Freedom Tower

Crane Accidents.com

Michigan Department of Licensing and Regulatory Affairs
Michigan Occupational Safety & Health Administration
Consultation Education & Training Division
525 W. Allegan St., P.O. Box 30643
Lansing, Michigan 48909-8143

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